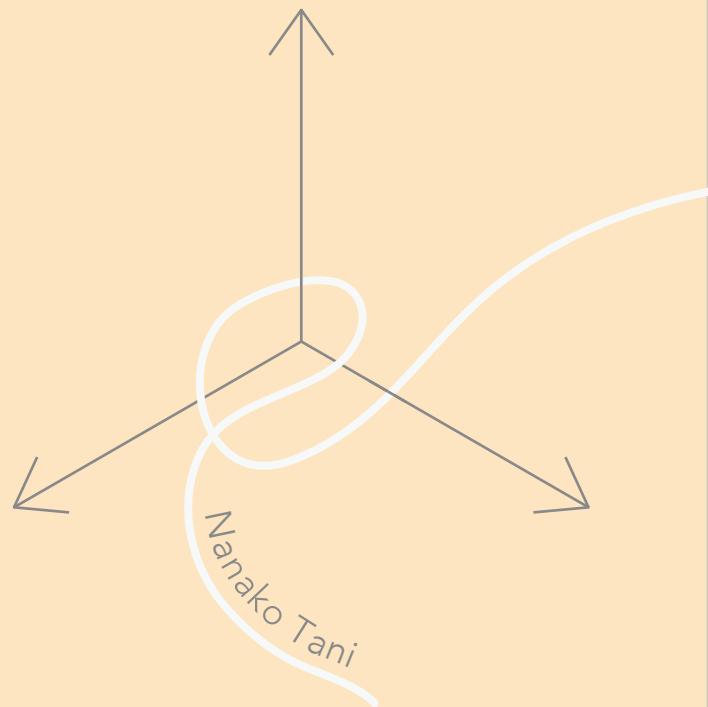


ENHANCING THE SPATIAL EXPERIENCE

Interweaving Textile, Human and Architecture



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Interweaving Textile, Human and Architecture

Nanako Tani

Master's Thesis

Textile Art and Design

Department of Design

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Supervisors:

Outi Martikainen

Pentti Kareoja

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0 Abstract

This thesis explores the potential of textiles in architectural space. By examining the relationship between textile, human and architecture, this thesis aims to provide information and to propose new ideas for designing enhanced spaces. The process consists of research through literature reviews and expert interviews, analyses, and several concept proposals in response.

The first chapter introduces the background and current relevance of the thesis. The research began with an interest in an architectural approach towards textile design. Textiles are no longer mere decorative elements; some architects, designers and artists have functionally integrated textiles with architecture. Although there are promising developments in the overlap between textile and architecture, no general overview exists. In order to maximize the potential of textiles to further improve our living environment, a broad understanding of textile design in relation to its users and surroundings is essential.

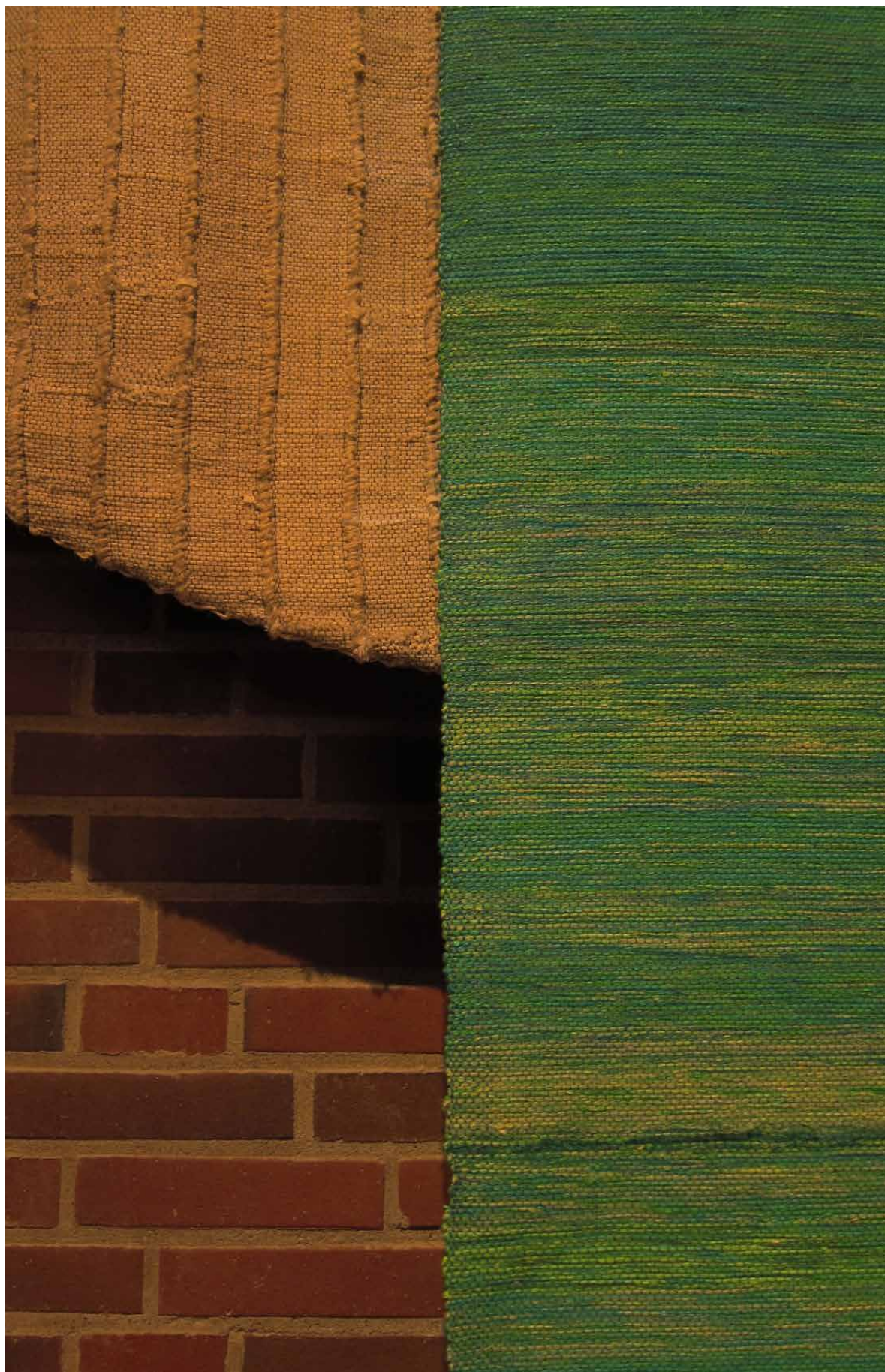
The second and third chapter form the research section of the thesis. First, historical relationships between the three elements of textile, human and architecture are examined. In fact, textiles have existed in architecture since antiquity. For the fundamental need to survive, humans wrapped themselves and surrounding spaces with textiles. However, the relationship and differing emphases of the three elements changed dramatically over time. At times, textile design has been less connected to humans and architecture. By addressing the transition of the relationship between the three elements, the potential of spatial textiles is rediscovered.

In the third chapter, the current roles of textiles in architectural space are explored. Textiles have developed to meet various needs that are functional, aesthetic and atmospheric. The examples in this chapter illustrate the numerous effects only textile material can achieve.

Taking the above research into account, the fourth chapter summarizes the evolution of textiles in architectural space. Furthermore, a future prospect of spatial textiles is discussed in relation to the evolving needs of our complex society.

Finally, three textile concepts are proposed in the fifth chapter. Each concept answers the urgent needs discussed in the fourth chapter by selecting and integrating the suitable functions. When textiles are designed in relation to the site and its users, the resulting spaces become comfortable, efficient and revitalizing. As a result, textiles enhance the spatial experience. In conclusion, the overall process and proposals are reviewed in the sixth chapter.

Keywords: textile, architecture, design, spatial design, interior design, curtain, weaving, history



1 Introduction

1.1 Preface

The Master's thesis *Enhancing the Spatial Experience – Interweaving Textile, Human and Architecture* describes the potential of textiles in architectural space. The thesis focuses on the relationships between textile, human and architecture, seeking aesthetic and innovative ways to integrate textiles with architecture through a multidisciplinary design process.

The content of the thesis consists of six major chapters. The introduction informs the reader of the background and relevance of the thesis, and sets the framing in this particular context by defining key terms. The second chapter reviews the historical relationships between textile and architectural space, ranging from the earliest shelters to decorative wall coverings, up to the modernist architects who were also keen on textiles. This chapter includes also a brief summary of the so-called “fabric architecture,” meaning tensile and pneumatic structures. The third chapter explains the current possibilities of textiles in architectural space in two parts: the first covering the functional aspects such as screening and acoustic control, and the second part introducing the more aesthetic, psychological and atmospheric aspects which further go hand in hand with architecture design. The fourth chapter summarizes the evolution of textiles in architectural space and contends their ways of contributing to the current society. Furthermore, the fifth chapter proposes new spatial textile concepts based on the findings. The first proposal is a light-reflecting, insulative and rotating curtain for the Helsinki Music Centre. The second proposal is an acoustically independent “pod” created by self-supporting structures. The third proposal is a more pretentious attempt to revitalize architectural space by combining tradition and innovation. Finally, the conclusion reviews the proposals and suggests a rich future for textiles in architectural space.

1.2 Background



Left, Fig.1 Petra Blaisse with curtains for Casa da Música in Porto, Portugal. / Below, Fig.2 Dutch Pavilion of the Architecture Biennale, Venice, Italy, 2012. Curtains by Inside Outside.



Personal Background

Having studied four years in the field of architecture, I came to believe that something was missing. Numerous hours of working late in the night and seeking concept after concept had not really produced real, tangible outcomes; perhaps some small-scaled models and large presentation boards. Since nothing was realized, I never could grasp the real scale of architecture, and many of the facts I just imagined in my mind. With the fear of not knowing enough to tackle the real world, I eventually became interested in designing in a smaller scale – meaning something more close to the human scale. As I was searching around different disciplines, textiles caught my attention, and with a vague idea that somehow they could be connected to architectural space, I decided to do my masters in Aalto University.

Learning textile design from scratch was completely different to what I was accustomed to. From the very first classes, I was facing the weaving looms and choosing my own weft yarns, producing small but real textiles with my own hand. The piece is designed, created, and done, right in front of you. The ways of critique contrasted as well, because we focused mainly on the structures, colors and the feel of the fabric, and only had general ideas of its actual ways of use. In architecture, we began with the context, not the materials. We first studied the site, its history, culture and surrounding environment, imagining people's interaction with the future building. Taking all the background research into account, we created concepts, and then started the building designing process. Although

nothing was realized, all the effort put into the research and ideation helped form concrete objectives, which guided us forward. As I gradually acquired more knowledge about textile techniques, I again noticed something was missing: this architectural input of the context. Textile and architecture both had their pros and cons, and I became determined to integrate their design processes, aiming to enhance one with the other.

During my studies, I came across several textile designers and coordinators who were actually doing what I had dreamed of. Here, I will shortly introduce two of the most influential designers in this overlapping field of textile and architecture.

- Petra Blaisse / Inside Outside

Petra Blaisse, head of the office Inside Outside in Amsterdam, is one of the most prominent figures in the design field today (fig. 1). She designs both textiles and landscapes, and she often collaborates closely with the architect and succeeds in integrating her designs into architectural space (fig. 2). Blaisse's designs build upon the architectural structure, each reinterpreting the other (Weinthal 2008, p.66). I am greatly inspired by her curtains which are more than just functional; they are an "unrelenting exploration of these reciprocities between movement, space and boundaries, and it seeks the enhancement of the construction and experience of multiplicitous and simultaneous narratives" (Heuvel 2006, p.280).

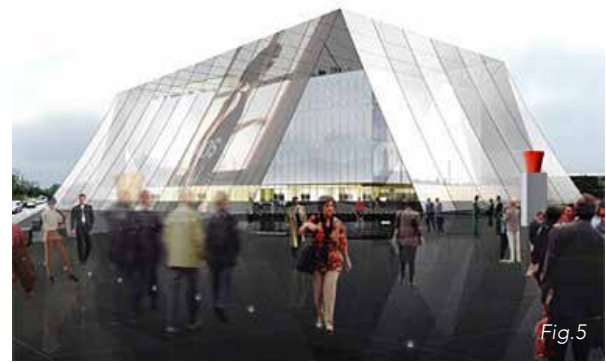


- Yoko Ando / Yoko Ando Design
Yoko Ando is a Japanese textile coordinator and designer. She is widely known also in the architecture field, as she mainly selects and combines innovative textiles for curtain applications (fig. 3). Ando used to work at NUNO, a unique textile company developing new fabrics in Japan, also for specific houses and commercial buildings (details and images on p. 110, 111). Her natural ability to communicate smoothly with architects has induced numerous collaborations, and she is approached by many famous architects such as Toyo Ito and Kengo Kuma. Ando also worked with a project to create spaces for temporary living after the devastating East Japan earthquake in 2011 (fig. 4).

The more I came across these two designers' works and ideas, the more I was intrigued by the integration of textiles in architectural space. I too began to aim to work in the overlapping field.

Current Relevance

Although there are countless differences between textile and architecture that could be listed, the relationship between the two fields has actually been present since the beginning of human history. As discussed in the following chapter, textile is considered to be the origin of architecture, according to German architect and critic Gottfried Semper



(Houze 2006, p.295). Textiles have been inside, outside, and also have been architecture itself. The use of fabrics as a material for temporary and massive structures such as tents and domes can frequently be witnessed.

In addition, the connection between textile and architecture is a rising topic at this current moment. Now, as buildings are erected and demolished in rapid cycles, architecture begins to take on a nomadic status. Mark Garcia (2006, p.10) states that “the shifting sites of architectural programmes in the accelerating cycles of economic global and sociocultural capitalist production systems leads architects and theorists like Herzog & de Meuron, Hani Rashid, Rem Koolhaas and other aestheticians to speed to conclude that conventional architecture is too slow to keep up with significant changes in society and culture.” Garcia further confirms that the relationship between architecture and textile “provides both a unique and illuminating account of the present state and possible futures of architecture and the city” (p.13). Architects are reconsidering textiles as a material and also as a metaphor. For example, architect Dominique Perrault’s works “demonstrate original spatial moves and concerns that have deepened the scope, depth and value of his particular manner of articulating the relationships between architecture and textiles” (Garcia 2006, p.29) (fig. 5).

In the textile field, Petra Blaisse and Yoko Ando are not the only designers who aim to integrate textiles with architectural space. More examples will be discussed

From left to right, Fig.3 Yoko Ando (right) with architect Teppei Fujiwara for the "Minna-no-ie" (Home-for-all) project. / Fig.4 "Majikiri" (Partition) project in Aizu-Wakamatsu. / Fig.5 Metz Centre Pompidou competition entry by Dominique Perrault, Paris, France. / Fig.6 "Building with Textiles Exhibition," Textiel Museum, Tilburg, the Netherlands. 2014-2015.



in chapter three. Recently, in the TextielMuseum in Tilburg, the Netherlands, an exhibition titled “Building with Textiles” was on display (September 27, 2014 to January 25, 2015) (fig. 6). This exhibition is part of a larger, long-term project initiated by the TextielMuseum and the TextielLab, and it comprises an extended research and develop plan spanning several years, with special commissions for the museum collection and also expert meetings (TextielMuseum 2014). In 2013, an exhibition titled “Textile Architecture” was held at the National Textile and Industrial Museum (tim) in Augsburg, Germany. Key magazines and books such as the “Architextiles” issue of Architectural Design (November/December 2006) edited by Mark Garcia and Textile Architecture by Sylvie Krüger have also contributed to collecting the scattered but overlapping projects in the textile and architecture realms.

Taking all of this lively discussion into consideration, I strongly believe in the potential of spatial textiles. With further collaboration and knowledge sharing between the two disciplines, spaces will evolve and become more flexible. However, few studies have focused on the relationships between textiles and architecture in a holistic scale. Only separate entities, such as tents, tensile structures, and contract textiles have been researched. A wider perspective observing textiles in architectural context is necessary to foresee the future needs in the living environment. For this reason, with this thesis, I will explore both the historical development and the emerging possibilities of contemporary textiles in architectural space.

1.3 Framing and Context

Multiple relationships exist between textiles and architecture. Mark Garcia indicates the four dimensions of “architextiles” (2006, p.8):

1. When an architect uses a metaphor from textiles or textile-based processes in architecture
2. When a textile-like spatial structure or form is produced in architecture
3. When textiles or textile hybrids and composites are used in the actual construction or materialization of architecture
4. When architecture engages with textiles through texts such as in fictional and theoretical writings

The most common researched relationship refers to the third, where textiles are the building structure itself. These examples ranging from tents, awnings and domes will be discussed in the following chapter. The first, second and fourth relationships are conceived from the architect’s point of view, and do not include actual fabrics or textile designers in the thinking frame.

Within this thesis, textile design is the main focus, but it is designed to integrate with architecture. The underpinning idea of spatial textiles requires them to be site specific, meaning that they are designed particularly for a certain site context. As textile designers collaborating with architects do, spatial textiles are designed based on the surrounding environment, benefitting the architecture and also vice versa.

To further examine the potential of spatial textiles, this thesis asks the following research question:

How can textiles be designed and implemented in a way that enhances architectural space and creates interesting relationships between textile – human – architecture?

Below, further explanation and definitions of the three key terms and their contexts are clarified.

Architecture / Architectural Space

- *What is architecture?*

Architecture is a broad concept – it does not square point to built structures and shelters. In the Merriam-Webster dictionary, architecture is defined as follows (“Architecture”):

- 1 : the art or science of building; specifically : the art or practice of designing and building structures and especially habitable ones
- 2 a : formation or construction resulting from or as if from a conscious act
b : a unifying or coherent form or structure
- 3 : architectural product or work
- 4 : a method or style of building

Architecture is not only an engineered assembly of solid elements, nor is it only a structural frame

creating a hollow space inside. Architecture can be a home, a school, an office, a roof, a shed, a giant multi-purpose facility, and it could even be an entire community. Each one differs from another, and they all have different environments, users, and contexts.

Although the process of architecture design should take all of these aspects into account, somehow the hidden minds of architects are perplexing to the general public. The quote cited by architect, educator and author Juhani Pallasmaa (2014, p.82) describes this situation:

Why is it that architecture and architects, unlike film and filmmakers [sic], are so little interested in people during the design process? Why are they so theoretical, so distant from life in general?

- Jan Vrijman, 'Filmmakers, Spacemakers,' *The Berlage Papers*, 11, January 1994

There are countless approaches to design architecture, and perhaps some architects do not place their users as their first priority. However, as Pallasmaa confirms, "qualities of physical space, behavior and our mental tuning are interrelated, and when designing physical spaces we are also designing mental spaces" (ibid.). It is impossible to create architecture that has no effect on human activity and thinking.

Another reason for Vrijman's concern is because architectural ideas are usually not initiated as clear and concrete forms. They are first fuzzy images or even vague feelings in an architect's head, and are gradually developed and concretized through the output of sketches and models, and refined numerous times (Pallasmaa 2014, p.83). These multiple layers of consideration, some of which are only inside the architect's head, may seem to disguise the architectural design process. However, without this continuous development, architecture would become monotonous, and identical buildings would be erected all over the world.

- Humans and architectural space

Similarly, "architectural space" is not simply just the inner dimensions of a building, and "interior design" is not just about the placing of furniture and lighting. Rochus Urban Hinkel (2008, p.82) states that "[t]he temporal, ephemeral, intangible elements and sensations within interiors, together with cultural connotations, preconceived knowledge and personal memories, also factor in the formation of interior atmosphere." Several contemporary architects show strong interests in space and its effects on both humans and the surrounding environment. For example, Cecil Balmond believes that "space is alive, it has qualities the moment we act in it – until then it has a sort of a nascent, infinite potential to act, things happen" (2005, p.406). Architectural space should provide different possibilities for different users. Spaces can also be designed through the process of imagining the human eye travelling through that space (ibid.).

Furthermore, "architectural space" in this specific context can be explained through the works of Inside Outside. Dirk van den Heuvel states that "[i]n Blaise's projects space exists in and as events – in and as the individual and collective interactions between users, inhabitants and their environment"

(2006, p.283). Architectural spaces are defined and become alive when movement and interaction between humans and their environment occur (ibid., p.280).

The importance of designing architectural spaces with consideration of the inhabitants is also discussed in the spatial design field. Shashi Caan suggests that “[i]n the end, the distinction between our spaces and ourselves is not so easy to determine. As Stanley Abercrombie writes in *A Philosophy of Interior Design*: ‘When we enter a building, we cease being merely its observer; we become its content. We never fully know a building until we enter it’” (2011, p.32). This observation directly connects to that of Winston Churchill: “We shape our buildings: thereafter they shape us” (qtd. in ibid.).

- Architectural space as context

Overall, this thesis considers architectural space as a context for textiles. Textiles add the necessary humanity to architecture, which enhances the human experience.

Therefore, architecture referring to textiles as a metaphor is excluded from this thesis’s frame. Although the comparison between the structures of textile and architecture also yields potential, it has less to do with the spatial perception within architecture. This discussion is further explored through Tiina Teräs’ masters thesis *Fabricated Tectonics: Two Shared Concepts in Architecture and Textile* from Aalto University, School of Arts, Design and Architecture.

In addition, “fabric architecture” is also omitted from the main discussion in this thesis. Even though tents and canopies definitely create architectural spaces, they are the architecture itself, whereas the “spatial textiles” in discussion create dialogues between textile, human and architecture. This thesis aims to investigate the potential of textiles that are separate objects but are integrated into architecture.

Textile / Spatial Textile

- What is textile?

The word “textile” is defined in the dictionary as follows (“Textile”):

1 : cloth 1a; especially : a woven or knit cloth

2 : a fiber, filament, or yarn used in making cloth

This is an oversimplified definition, because textiles usually consist of numerous structures, materials, colors and textures, and the combination of these elements produce an infinite variety of “cloths.”

Another misconception is that designers who usually design three-dimensional objects and spaces, especially architects, often perceive textiles as a flat surface. Actually, textiles are not flat at all; techniques such as weaving and knitting require yarns to intertwine with each other, creating uneven surfaces, perhaps in a smaller scale compared to other design disciplines. The process of screen-

printing can be considered three-dimensional as well, if you zoom in to the ink that goes on top or seeps through the fabric.

In the architecture field, textile structures may be miniscule compared to steel structures and concrete columns, and the details are generally invisible unless you are interested to look up close. However, these visually small components of textiles do affect the feel and function of the placed space in the end, and should be highlighted as a significant aspect of interior design.

- ***“Spatial Textile”***

Curtains bring sensuality to these hard-surfaced spaces. They make gravity visible, light apparent, they curve and move and are full of association. The curtains make a primal connection between space and people: the stuff that wraps our bodies and touches our skin becomes an element of architecture.

- Tim Ronalds, 2005. *Inside Outside*: 102.

This quote by Tim Ronalds explaining the works of Inside Outside best defines the textile's role in this thesis context. Textiles, which have been designed considering the visitor's perspective and its surroundings, can bridge the human and the architecture, in both physical and emotional ways. To achieve this connection, Inside Outside proposes window curtains, stage curtains, and also floor rugs designed specifically for a site. Since curtains usually move on tracks and are positioned slightly away from a solid surface, they are the most associative of textiles, as stated above. These kinds of textiles will be referred to as “spatial textiles.” Although interactive elements could be brought into other interior textiles such as rugs and upholstery fabrics, they will be less regarded in this context. Fashion fabrics are also sometimes referred to as the closest “architecture” to the body, but their structure depends on the human body and they do not bring the fluidness to architectural space that spatial textiles would.

“Spatial textiles” are site-specific, meaning that they are designed according to a particular site, in order to enhance the architectural space as much as possible. This does not necessarily mean that the fiber material and structure are designed every time; the selecting of the most suitable fabrics from existing collections can also be a site-specific process. Of course, experimental textile-like materials are sometimes invented from scratch to achieve a certain affect, but only those with the abundance of tools and experience are able to initiate the design process from that early of a stage. Furthermore, Petra Blaisse of Inside Outside puts effort into going through this type of process, by researching into new techniques and materials, “often to discover that these are not (yet) applicable to...public building projects because of time, safety, wear, maintenance or budget reasons” (Weinthal 2008, p.69). This confirms the existence of the technical and restrictive aspects of textile design in public space. Even if you had all the necessary tools for designing and producing site-specific textiles from the beginning, strict regulations and specifications may disrupt all of your plans. The Master's thesis by

Victoria Fislage of Aalto University, School of Arts, Design and Architecture, titled *Textiles in Transit: An Investigation of Contract Textiles in Airport Terminals* covers this field of contract textiles. Designers should not be discouraged, however, to limit their imagination, and continue to strive for innovation. When designing from scratch or coordinating with existing fabrics, textile designers should be further informed of the environment that needs or could need textiles, in order to propose efficient and visually satisfying solutions.

Furthermore, several other overlapping concepts between textile and architecture are omitted in this context. First, some textile designers are also surface designers, ranging from postcards or graphics on tableware to even architectural surfaces such as glass facades and concrete. Architectural surface design, like “fabric architecture,” is also an important profession. However, both focus on actual building materials, and contradict with the “spatial textile” idea. Second, “fabrication” is a term used in the architecture field, and there is also the concept of “fabric” in construction context. These terms do not relate directly to soft textile materials, since the word “fabric” has broad meanings (“Fabric”):

- 1 a : structure, building
- b : underlying structure : framework
- 2 : an act of constructing : erection; specifically : the construction and maintenance of a church building
- 3 a : structural plan or style of construction
- b : texture, quality – used chiefly of textiles
- c : the arrangement of physical components (as of soil) in relation to each other
- 4 a : cloth 1a
- b : a material that resembles cloth
- 5 : the appearance or pattern produced by the shapes and arrangement of the crystal grains in a rock

In this thesis, definition four, meaning textile fabric, is the main “fabric” in discussion.

Human / Human Perception

Last but not least, humans are ultimately the most important factor of design. As briefly discussed in the Architecture section above, humans are more or less connected to their surroundings – they pass through, linger in, use, inhabit, and occupy a space, and are also able to create or destroy space. Humans interact with their surrounding environment, and often changes it because “the improvement of the human condition is at the core of all design. Design is the deliberate intervention in our environment to ameliorate the conditions of our existence” (Caan 2011, p.20). This does not mean that designers should listen to every single human need, and often the heavy prioritization of

humans has led to massive environmental mistakes. However, when humans are excluded from the design process, these problems we have caused cannot be solved either. Without human-friendly spaces, our society would completely lose its already unstable balance.

So how is architectural space related to humans? How do you design for humans? As an acoustic consultant of architects, Renz van Luxemburg explains that “[d]esigning and creating spaces requires knowledge of perception, and therefore of human psychology and physiology” (2005, p.220). Human perception is an important factor in many design disciplines. For example, Daniel R Montello explains the significance of considering cognition and perception in architecture as follows (2014, p.75):

Architectural design affects sensory access – what can be seen and heard; attention – what is looked at and listened to; memorability – what is remembered about a building; knowledge – how one reasons and makes decisions; behavioural affordance – where one walks, sits and so on; affect – what one feels, including one’s mood, comfort level, stress and fear, and aesthetics; and sociality – with whom one interacts socially, as a function of factors such as pedestrian flows, noise levels, social distances and body postures.

Perception is an intangible and vague sense that humans inherently have, but at the same time tangible and concrete objects constantly influence us. With careful consideration and designing of the spatial environment, human senses can be enriched and multiple dialogues between architecture, textiles and human flourish.

Framing - Summary

In short, this thesis concerns the designing of spatial textiles in architectural environments, aiming to develop narratives between textile – human – architecture. When these textiles are integrated with the architectural concept, they reinforce the qualities of architectural space, which enhances human experience. To achieve this intended reaction, a holistic design approach is necessary. Details of these multiple aspects will be explored in the third, main chapter. Although the terms are defined in the context of textile design, this approach is relevant for any designer who is interested in adding more meaning to their creations.

2 Historical Overview

In order to create new relationships between textile – human – architecture, it is important to first look back into the past. Strong bonds between textiles and architecture have existed for centuries, and actually soft materials have sheltered humans from the beginning of our history. In this chapter, the various narratives between these three elements are introduced with the focus on their interrelationships and how they have been designed in relation to one another. This background research provides the knowledge that is necessary to propose long-term solutions, as well as creative inspiration.

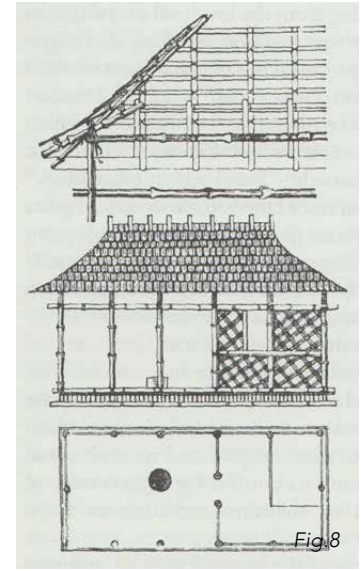
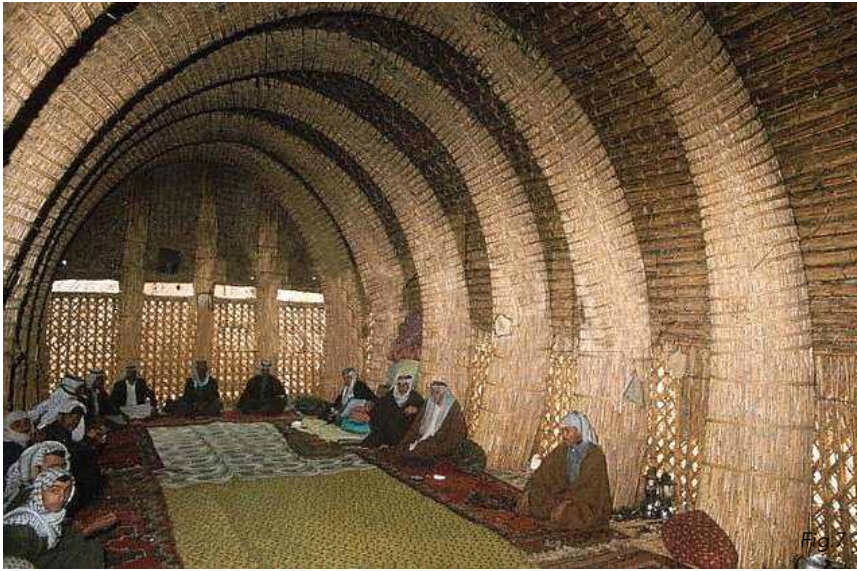
2.1 The Beginnings

Textile Origins in Architecture

When speaking of the relationship between textile and architecture, almost all writers first refer to the architect and theorist Gottfried Semper (1802-79). In his writing “The Four Elements of Architecture,” Semper goes back in time and refers to “the primitive conditions (Urzustände) of human society” in order to search for the origins of architecture (Semper 1851, p.102). According to Semper, humans first settled around the hearth, which became the central element of architecture. The roof, the enclosure, and the mound were created around the hearth to protect its flame against nature. Based on these four elements, human cultures developed, and various emphases on them according to the society and their surroundings led to their different combinations. Semper further describes the enclosure, asserting that the carpet wall, “a vertical means of protection” (Semper 1851, p.103), had great influence on architecture.

Tree branches were woven together to form the most primitive enclosures. This “wickerwork” led to the weaving of bast, or plant fiber, and other fibers as well. Before stiff masonry structures were developed, wickerwork, mats and carpets were used for insulation and to surround and subdivide spaces. Semper states that although solid walls were necessary for security and to support a load, they were subsequent to fabric hangings, and had no relationship to the creation of the space. He even proclaims that later decorations on wood, stucco, clay, metal, or stone were imitated, although unconsciously, from the old carpet walls. One example of textile-influenced architecture is seen in Mesopotamian temples. The original textile structure, which in this case is not necessarily a carpet wall, is the reed construction used by the marsh Arabs. Tall reeds were bundled together to form columns, which were bent into arches (fig. 7). Mesopotamian temples translated these elements into external buttresses and semi-attached columns (Ball 1980, p.19). In this use they had no structural function, but they added rhythm and interesting shadow effects to the interior space.

In the colonial section of the Great Exhibition in London, held the same year when Semper’s “The Four Elements of Architecture” was published, Semper discovered a “Caribbean Hut,” also called the “Primitive Hut,” which confirmed his textile-wall theory (fig. 8). Later on, he recalls this primitive structure that “[i]n it appear all the elements of ancient architecture in a highly original manner and without adulteration: the hearth as the center, the earthen platform surrounded by the pilework as a



terrace, the roof on columns (pillars), and the woven bamboo mat (fence) as a space divider or wall” (qtd. in Vogt 1984, p.xii). This finding of a “completely realistic instance provided by ethnology” (qtd. in *ibid.*) enabled Semper to develop his initial idealistic ideas into more pragmatic theories.

Overall, Semper believed that textiles were the original enclosures of architectural space. Various trends over time have both hidden and reintroduced textiles repeatedly, but it is worth mentioning that humans have had intimate relationships with textiles in their surroundings since prehistory. Furthermore, humans are most likely to be wrapped in cloth the moment we are born. Textiles have strong relationships to the beginnings of human life and culture.

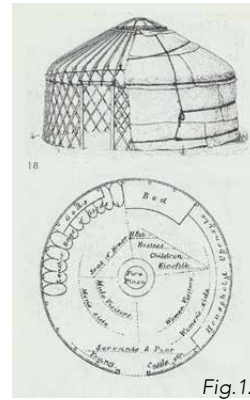
The Earliest Shelters - Tents

Ephemeral architecture is said to be the first form of building of mankind (Kronenburg 1995, p.9). Even before the emergence of Homo Sapiens, there seems to have been primitive shelters made of animal skin. Kronenburg (*ibid.*, p.13) describes a mid-Pleistocene (150,000 years old) excavation, at Grotte du Lazaret near Nice in France. There, traces of a large hut, measuring 11 meters long and up to 3.5 meters wide, was built against the cave’s wall. Only stones that are estimated to have supported upright posts have been found, but they were probably covered with animal hides. A sure existence of fabric structures can be traced back over 44,000 years to the ice age and the Siberian Steppe, where simple shelters made of animal skins and sticks have been found. The pure human need of warmth led our ancestors to use soft materials to surround the body and also the intimate space around the body. There are also speculations that textiles were utilized for spatial division and shelter even before they were worn as clothing (Harvie 2014). These shelters contain the most primitive relationship between textile – human – architecture, where the human is warm and safe inside a textile-based architecture. Furthermore, Kronenburg states that migratory peoples “have an intimate understanding of their place in the landscape which extends to the relationships between their buildings and even to the layout of the interior spaces” (1995, p.10). The surrounding environment is a fourth element in the relationship, and it plays a key role in the choosing and placing of materials for shelter.

From left to right, Fig.7 A Mudhif, or reed house of the Marsh Arabs. / Fig.8 Caribbean hut. (Der Stil, 2, p.276)



Fig. 9



2
1

There are various types of tents, some of which are still used in a number of societies who have kept their nomadic culture. From these surviving structures, it is possible to obtain information about the earliest form of dwellings.

Tents are easy to construct, take down, and transport. Their refined, efficient structures can also adapt to varying climatic and weather conditions (Krüger 2009, p.142). Humans learned from experience which textile materials were most suitable for which climate, therefore creating the best shelter for any particular situation. Long ago, humans were, by nature, architects.

In some cases, the ceiling and the wall are indistinguishable. For example, the traditional housing of the North American Indian, the tipi, is a conical tent (fig. 9). The tent skin was originally made of bison or buffalo skins sewn together, which was later replaced by canvas. Although it is one of the simplest structures among tents, the tipi is very functional and comfortable, in that even a fireplace could be placed inside the tent. At the tent's highest point, there is an adjustable smoke flap, allowing air circulation. The interiors are lined with a dew cloth to keep out draughts and allowed the moisture to escape (Krüger 2009, p.142; Kronenburg 1995, p.16).

Another example is the 'black tent,' or in the Arabian Bedouins' language the 'house of hair,' used in North Africa (fig. 10). The Bedouins are called the 'nomads of the nomads,' travelling as much as 64 kilometers in a day (Kronenburg 1995, p.18). Textile materials also play an important role in this structure, because the black goat hair provides perfect protection against rain. When it becomes damp, it contracts and becomes waterproof, reinforcing its original smooth and oily characteristics (Krüger 2009, p.142). Furthermore, the weave consisting of strips between sixty and seventy meters is light enough so as to allow some air to flow in and out. In winter, additional side-walls are added. The black tent even has dividing curtains that

separate the interior space into the reception, men's section, and the women's section (ibid.).

The Tuareg of the central and southern Sahara use tents covered in either skins or mats (fig. 11). Its unique structure consisting of bent poles create a dome-like roof, clad with mats made from various plants. Plants were placed according to the intended function; Dum palm plants outside and plant stems inside (Kronenburg 1995, p.19).

The fabric structure of the Asian yurt is also made to be very functional, and has been standardized for centuries (fig. 12, 13). Yurt, or yurta, is the Turkish word for dwelling (ibid., p.20). The structure consists of strips of willow, connected with revolving joints. The tent's felt coverings, made by the dwellers, are laid to overlap up to eight layers. They are not sewn together, but the multiple layers provide the necessary water-resistant function. Furthermore, individual parts can be opened or closed depending on the exterior climate.

These tents were modified and mixed into various forms, and spread throughout indigenous peoples such as the Eskimos, Sami and Siberian pastoral peoples (Krüger 2009, p.143). As the most basic forms of dwelling, they have inspired architects of industrially constructed buildings as well. Further developments in tent structures will be discussed in the following section.

Opposite page, Fig.9 Cloth Covered Tipi. / From left to right, Fig.10 Bedouin tent. / Fig.11 Erection procedure of a Tuareg mat tent. / Fig.12 The Asian yurt, showing the structure and the interior space layout. / Fig.13 Yurt. 20th century. Mongolia.

2.2 Prehistoric Spatial Textiles and Ancient Civilizations

Prehistoric and Early Historic Periods

Textile materials are mostly transient. This means that early examples are extremely rare, and if there are any at all, they have luckily been stored under the perfect archaeological conditions. So from a few archaeological finds, ancient writings and illustrations, partial clues have provided us some facts of the earliest societies and their people.

The purely functional fabric walls of shelters gradually obtained more meaning. Mobile walls evolved into more decorative pieces, which we now call tapestries. In the palace at Mari in current Syria, a fringed and patterned textile was discovered, which was used as a wall hanging. Dating from eighteenth century B.C., it is estimated to be one of the earliest tapestries in history (Ball 1980, p.47). An even older textile example was found in the tomb of Queen Hetepheres I of Egypt, who reigned during the fourth dynasty (c. 2613 to 2494 B.C.). Inside were boxes of fine linen used for bed canopy and curtains.

However, the way these textiles were placed in relation to architecture is not known. We can only maintain that they have been important elements in the living environment for over four thousand years.

Ancient Rome: 1000 B.C. to A.D. 476

It is possible to form a clearer picture of ancient civilizations as they flourished more and more. In ancient Rome, various examples of spatial textiles can be found, together with the exceptional architecture. With the phenomenal growth of the empire, new spaces were constantly in demand, and buildings grew both horizontally and vertically. Ball states that Roman architecture was decorated almost from its very beginning (1980, p.125). However, this is not due to the Romans' need of decoration, but to the strengthening of "the sense of movement and space" in their designs (ibid.). According to Semper, residential buildings also had draperies for dividing the space, which were hung on movable scaffolds (Krüger 2009, p.29).

One such building is the House of the Surgeon, in Pompeii, Italy, which was built before 200 B.C. (fig. 14). It is made of large limestone blocks typical of early construction. The different rooms and spaces within this house are recognizable, and one can imagine how humans moved through the space. A vellum or curtain may have been the only partition between the corridor and the main room or court (Ball 1980, p.104).

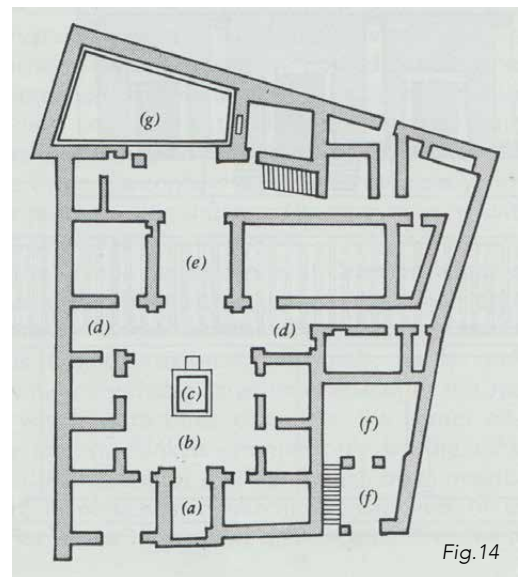


Fig. 14 House of the Surgeon, Pompeii, Italy, before 200 B.C.

(a) vestibulum; (b) atrium; (c) impluvium; (d) alae (e) tablinum; (f) tabernae opened to street, (g) oecus. (Adapted from Bertha Carr Rider, Ancient Greek Houses, Argonaut, 1964.)



Fig.15

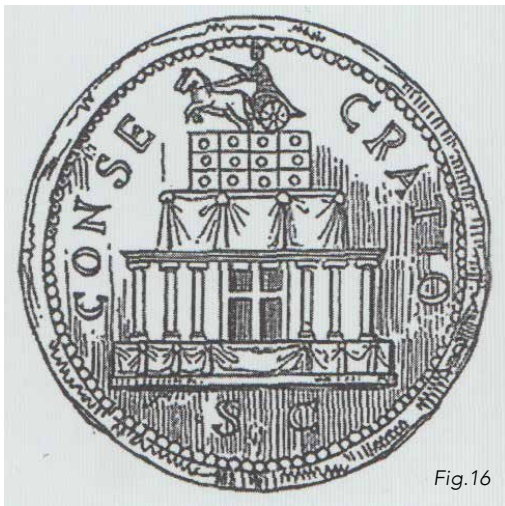


Fig.16

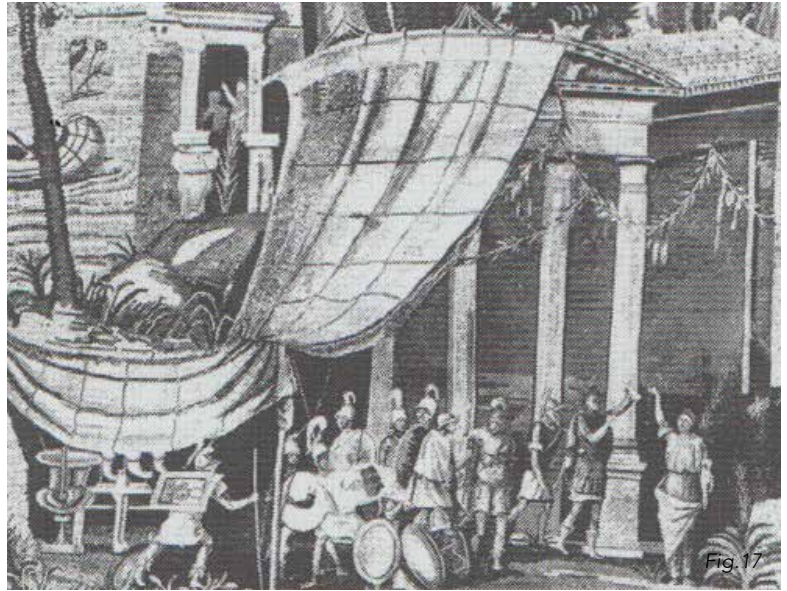


Fig.17

Above left, Fig.15 Mosaic from Centocelle, depicting a day bed. First century. / Left, Fig.16 Draperied funeral pyre, Roman consecration medal. / Above, Fig.17 Sun shade in front of a temple. Mosaic from Praeneste, 80 B.C.

Windows and inner doors were sheltered by portieres (*velli*), which were hung from wooden rings. As well as vellum, a substance called *lapis specularis* was occasionally used. These were like fine sheets of mica, a glossy silicate material found in rocks.

Beds also already had fabric coverings from antiquity, as can be seen in a mosaic from Centocelle, Rome, of the first century (fig. 15).

More decorative examples are depicted in various writings. "At a banquet held by Cleopatra for Antonius, the walls of the grand chamber were enveloped in gold-embroidered purple hangings" and "[a]t the wedding banquet of the Macedonian Caranus, an oikos was draped in white batiste draperies, which opened to allow torchbearers to step forward" (qtd. in Krüger 2009, p.27). Outside monuments, public squares and streets were also often decorated with magnificent draperies. For the festive procession of Manius Valerius Maximus Corvinus Messalla (263 B.C.), canvases depicting scenes of the victory over the Carthaginians covered Rome's monuments (ibid., p.26). On the other hand, the great masters' timber

scaffoldings with abundant draperies were burnt at burial ceremonies (fig. 16). In fourth century B.C., Alexander had a multilevel funeral pyre with precious fabrics, and Semper mentions the Roman Emperor Septimius Severus' funeral in 211 A.D., when gold-embroidered covers of a multilevel funeral pyre were burnt (ibid.). For both merry and gloomy occasions, these textiles were the dominant source of the whole atmosphere of the event. Before textiles began to be produced industrially in great amounts, they had greater value and abundant use stood for wealth and prosperity.

Another spatial textile often referred to is the Roman awning. The Romans are known to have covered the openings over streets, squares, theatres, amphitheatres and stadiums, to protect themselves from the sun. These large, retractable roofs are called *vela*, meaning sail in Latin. An early example can be found from a mosaic from the Sanctuary of Fortuna Prinigenia in Praeneste, about 35 kilometers east of Rome, from 80 B.C. (fig. 17). The Roman consul Quintus Lutatius Catulus is said to have hung a *vela* over a Roman theatre for the first time. The roof over Colosseum, the largest amphitheatre during the

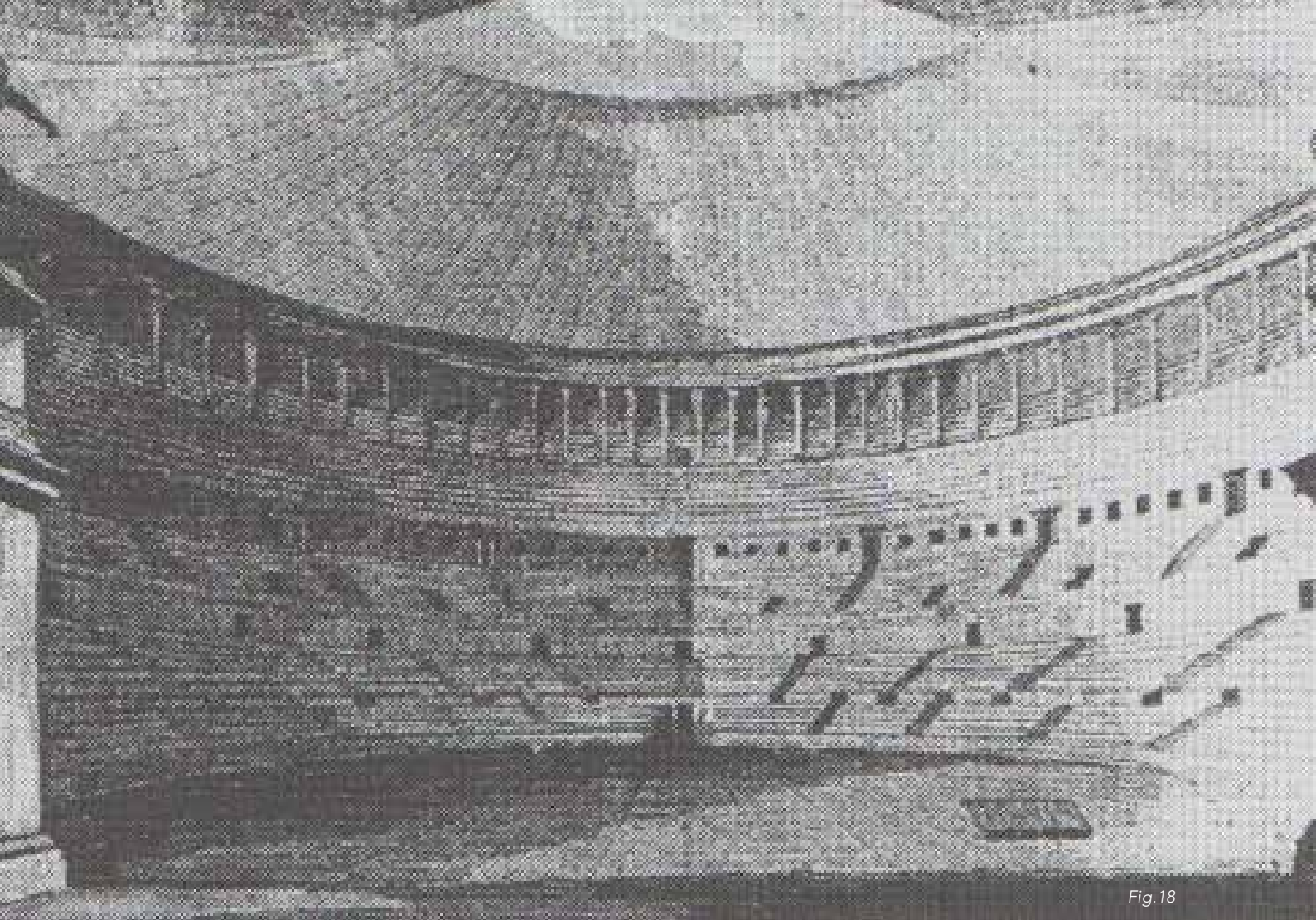


Fig.18



Fig.19



Fig.20

Opposite page, top, Fig.18 Vela roof of the Colosseum, reconstruction by Canina, 1851. / Bottom left, Fig.19 Assyrian tent, relief in Nineveh, Assyria. 705-681 B.C. / Bottom right, Fig.20 Carpet holders as decoration on back rests, Kujundshik, Mesopotamia.

era, must have covered an unbelievable area of 23,000 square meters (fig. 18). These roofs were retractable; not due to adjustment reasons, but more for the vulnerability of its large surface to rain and wind. The vela were made of linen, and during the late Republic also cotton awnings emerged. They flooded the enormous spaces with the color of the fabric, which was for example yellow, rust-red, and sky-blue, and was sometimes embroidered. The emperor Nero erected a vela that imitated the night sky (ibid., p.91). These vela were not only functional; some were aesthetically pleasant and perhaps helped to unify the immense space underneath.

Other Ancient Spatial Textiles

Although tents were created in order to meet the most basic needs of humans, they evolved to have additional meanings among settled peoples as well. Some examples are the audience tent and marriage tent of Alexander the Great (356-323 B.C.). The Greek rhetorician Athenaeus described this marriage tent as follows: "Moreover, the construction was costly and magnificent, adorned with expensive draperies and fine linen and lined with purple and crimson carpets, which were interwoven with gold" (qtd. in Krüger 2009, p.143). Here, tents are not used for pure shelter but for a festive occasion. Similar to the temporary tents of today, their easy construction symbolizes the short but eventful happenings. Alexander the Great's audience tent was embellished with embroidery and supported by golden poles (ibid.). In the Greek play *Ion* by Euripides (approximately 480-406 B.C.), a large tent in the area of Delphi is described. Its interior was completely clad in tapestries from the temple treasury (ibid., p.27). Tents were also used for military purposes, for example an Assyrian tent from an army camp is depicted in a relief in

Nineveh, Assyria (modern Iraq) (fig. 19).

In Egypt, the festival tent of Ptolemy II (around 275 B.C.), is said to have covered an area of about 8,200 square meters. Wooden columns supported a horizontal wooden frame, on which a scarlet fabric was placed. Even a corridor existed; on three sides, richly decorated curtains of the same color surrounded the interior (ibid., p.143).

In terms of actual textile evidence, for its dry climate, Egypt has preserved a number of exquisite materials until this day. Old – recent in terms of antiquity – examples are the Coptic tapestries and textiles of Christian Egypt. Coptic textiles are fabrics produced in Egypt between its introduction of Christianity and the conquest by the Arabs in A.D. 640. From this period, large rectangular textiles have been discovered, which could have been used either as cloaks, blankets or hangings. In some of the earlier examples, there are decorative areas of looped tapestry, which gives the fabric greater bulk and warmth. Some are entirely tapestry woven, creating an all-over pattern.

An interesting example is mentioned by Gottfried Semper in his renowned publication *Der Stil in den technischen und tektonischen Künsten oder Praktische Ästhetik*, Volume 1 of 1860 (ibid. p.29). According to Semper, in Mesopotamia, servants held up carpets during festive occasions at holy places (fig. 20).

Overall, textiles of various sizes and decorations have existed since ancient times. Functions were presumably limited to shading, temperature insulation and privacy. However, since the architecture had simpler structures and arrangements than those of today, textiles may have been spontaneously hung, draped or covered according to a person's immediate needs or feelings. Before the emergence of permanent fittings and furniture, both interior and exterior spaces were more fluid and flexible. Perhaps architecture in the future will be somewhat similar to what it was two thousand years ago.

2.3 Spatial Textiles of the Middle Ages

The Middle Ages

After 2 A.D., the Roman Empire gradually lost power over its enormous territory. In 286, the empire was split into east and west, and Constantine the Great newly founded the eastern capital Constantinople, the former city of Byzantium. It was this Byzantine East where Byzantine Art flourished in a time of prosperity. Many innovations were introduced through trade routes from the east, and Christianity also affected the entire culture. Luxurious palace buildings were erected, containing opulent materials such as textiles, ivories, mosaics, metalwork, and enamels (Ball 1980, p.133).

A strong influence in architecture was the treatment of light, which then became a design element. The Hagia Sophia, with one of the most significant interior spaces in Christendom, illustrates this feature (fig. 21). Ball writes that “[t]his great building with its myriad candles of light flickering through its many small windows and its reflections from glass mosaics and resplendent metals anticipated designing through light” (ibid., p.137). Furthermore, ornamentation such as the incising of the columns created dark shadows. It is claimed that these cuts on the surface actually spread the light, creating chromatic color, and Ball describes that the effect results in “a lighter, scintillating, textured fabric” feel (ibid., p.138).

Magnificent textiles were often owned by the Christian church. The *Liber Pontificalis*, written by medieval popes, gives an idea of the amount of curtains in churches, mostly during the eighth and ninth century. Krüger quotes as follows (qtd. in 2009, p.29):

“Pope Leo IV donated to St. Peter’s alone: three for the main entrance, forty-six for the central nave, ten for the confessional, twenty-five for the high altar, thirty-four for the presbytery and eighteen for various other places. And more than 1,000 curtains are listed under Hadrian I (722-795), which the pope gave to various churches in Rome.”

After the East-West Schism of 1054, when medieval Christianity split into two branches, each had specific usage of textiles in its church architecture. In the Eastern Church, the most sacred area, the altar, was surrounded with curtains and parapets. In the West, it was usually surrounded by a canopy raised on columns, which is known as the baldachino or ciborium (Ball 1980, p.142). The term baldachino comes from the Italian name of the city of Bagdad, “Baldacco,” and described a brocade-like silk fabric embroidered with gold thread from that city (Krüger

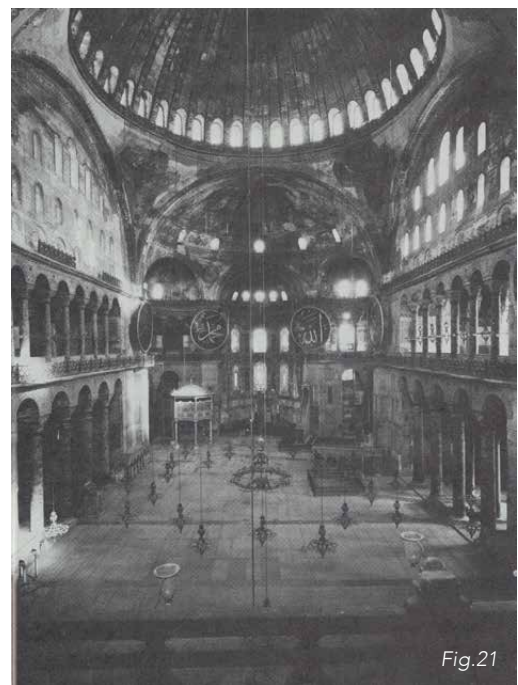


Fig.21

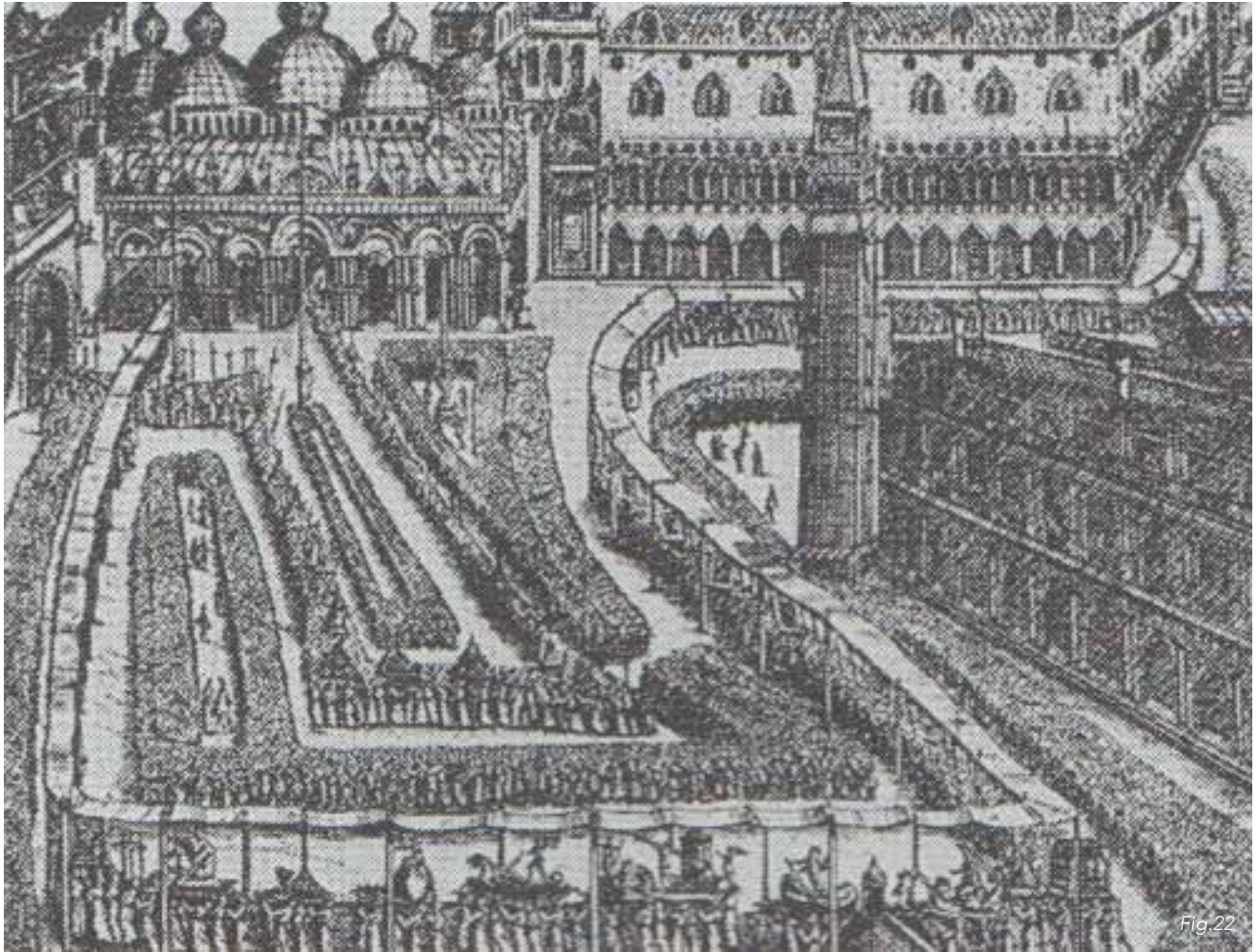


Fig.22

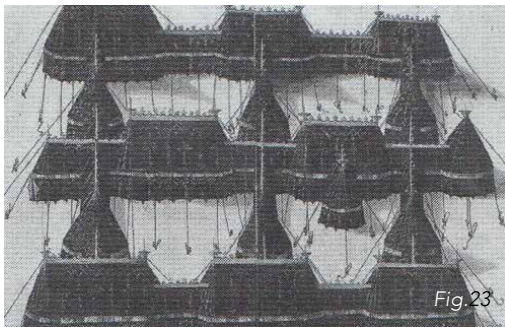


Fig.23

Opposite page, Fig.21 Church of the Hagia Sophia, interior, Istanbul, 532-537. (Hirmer Fotoarchiv München.) / From top to bottom, Fig.22 Procession for the Feast of Corpus Christi on St Mark's Square in Venice, seventeenth century. / Fig.23 Camp du Drap d'Or, 1520.

2009, p.90). The term also refers to architectural structures, and was not necessarily made of fabric material. Baldachin was also used in processions, like the portable canopy of the Feast of Corpus Christi in the fourteenth century. The sight is depicted in a seventeenth century drawing, where an endless textile "snake" covered an entire square, moving as the dignitaries walked through Venice (fig. 22) (ibid.).

Tents were still erected for festive occasions, perhaps in a larger scale than before. When the Dukes of Burgundy, who were among the richest rulers of their time, visited the King of France in 1389, a special tent was built for the occasion. It required 30,000 ells (20,500 meters) of linen, and despite the effort, the material was ruined shortly after use due to bad storage (Phillips 1991, p.33).

Another large-scale example is the "Field of the Cloth of Gold" of 1520. For the encounter of the King of France, Francis I, and the King of England, Henry VIII, a "Camp du Drap d'Or" was built near Calais in France (fig. 23). Four hundred tents housed five thousand people and three thousand horses, and the spectacular sight and gold embroidery on the costumes gave the event its name. Some tents are said to have resembled palaces with multiple rooms (Krüger 2009, p.143). On the other hand, a crimson tent measuring 46 meters was built in England, also during early sixteenth century. It was decorated with both French fleur-de-lis and Tudor roses to imply their diplomacy. The tent consisted of four pavilions, connected with lower galleries, which were each flanked by a set of parasol-



Fig.24

roofed tents (fig. 24) (Drew 2008, p.19).

Meanwhile in interiors, beds were commonly covered with fabrics, providing warmth and privacy. Gibbs states that “the earliest [bed] draperies were held up on rods stretched across the room by means of cords attached to hooks in the ceiling” (1994, p.15). They did not have posts, so early draperies were “floating” and more free, before they were integrated to become one piece of furniture. During the day, the curtains were drawn together and put into bags, which hung from the canopy (fig. 25).

Actually, fabric was eventually everywhere in a room. For the birth of John, a son of Philip the Good, the mother was provided with “a State bedroom with silk-covered walls, brocade bench pillows and a bed canopy embroidered with a golden sun” (Phillips 1994, p.33). Philip the Good is known to have been very rich, and in the 1467 inventory of the goods to be inherited by his son, numerous textiles are to be seen (ibid.):

There is table linen; 22 sets of voluminous bed curtains; brocade, samite, satin, damask, velvet and camlet; 15 pieces of gold brocade with several 39 and a half ells long” (around 27 meters); “15 sets of vestments, the mitres laden with jewels and the copes and chasubles gleaming through the ages encrusted with gold and precious stones, bordered with gold work and embroidered with saints, angels and inscriptions. ... Finally, there are the pride of the Duke’s collection, the tapestries. There are 86 sets, battle scenes, myths, legends, emblems, bible stories.

Tapestries and Architecture

The styles seen in textile designs mirror the developments in the architecture of that period, for example in *Opus Anglicanum*, or English needlework. The liveliness of the Anglo-Saxon work is replaced by more solid Romanesque in the twelfth century, and the Gothic style is evident in thirteenth century work.

The most important textiles during the Middle Ages were tapestries, as medieval buildings with stone walls required fabrics to provide comfort and be draught-free. In tapestries, there may be small slits due to the technique of weaving partial areas of warp with the weft yarns. These slits were consciously used to create deep shadows in the design, rather than

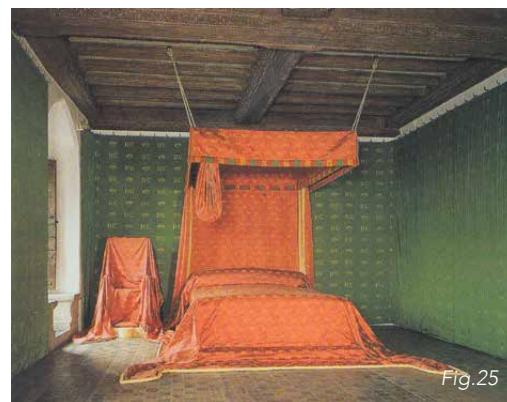


Fig.25

From left to right, Fig.24 Henry VIII's tent. From MS 3: Cotton Augustus, folio 18. 16th century. British Library, London [UK]. / Fig.25 Reconstruction of a medieval bed, which could be dismantled and moved around from house to house. During the day the curtains were put into the bag suspended from the canopy. / Fig.26 The Apocalypse Tapestry, France, fourteenth century. Cathedral at Angers. (Lauros-Giraudon.)



relying on dyed colors alone, creating an “intaglio effect” (Ball 1980, p.194). Due to this effect, the color obtained with yarn appeared differently from flat color on a tapestry cartoon, or preliminary design.

Originally, tapestries were used as moveable furnishings, and therefore needed to be durable enough to be transferred from one place to another. In fact, a nobleman in the fourteenth or fifteenth century England is said to have led “a nomadic life,” as he travelled between manors of castles, taking his belongings and even his household, with him (Clabburn 1988, p.81). Therefore, tapestries were initially not designed to fit certain spaces. They were also temporarily installed as decorations for festive occasions. By the seventeenth century, they became adjusted to fit a particular room, sometimes even cut according to the fireplace or window beneath, or went around a corner if it was too big for one wall.

Tapestries were generally hung on rods attached to columns or walls. There was a small space in between the fabric and the wall, which was a passage for servants to use.

Tapestries were not only used inside, but outside the building as well. During the Middle Ages, they were occasionally used as decorations in the streets, for events such as the coronations of processions. They were also combined with tents for military campaigns.

Gothic Architecture and Textiles

The Gothic style of architecture explored a new and unique spatial expression. By 1200, even before the former Romanesque style had ended, the rib vaults, pointed arches, and flying buttresses had characterized Gothic architecture. These design elements evolved from the problem solving of former structures, but once they were solved, architects ventured with its aesthetic potential. Gothic churches grew in height, and walls near the ceilings

began to dissolve in the distance. In contrast to the solid box in the Romanesque tradition, Gothic architecture is like “a textural net that encloses tremendous pulsing space” (Ball 1980, p.162). Ball continues to explain that “[i]t is a lattice in which all of the separate parts are meshed to provide unity with interpretation of exterior and interior in an unprecedented manner” (ibid.).

Gothic tapestries are recognizable due to their narrow borders or borderless designs. Similar to Gothic paintings, their patterns are two-dimensional, but are rich of texture. Therefore, Gothic tapestries are suitable for wall hangings, since they do not interfere with the perspective created by the walls. Furthermore, the vertical light shafts, which enhance a good tapestry, go in harmony with the pointed verticality of Gothic architecture (ibid., p.195). Although there is no perspective in these tapestries, the fabrics adorning the figures illustrated are skillfully designed with different colors, “to create a superimposed rhythm on the basic patterns, altogether a remarkable creation as complex and diverse as the web of late Gothic architecture” (ibid., p.198).

The Apocalypse of Angers, woven during the reign of the French King Charles V, namely Charles the Wise (1364-1380), is one of the most famous tapestries of the early Gothic period (fig. 26). Nicolas Bataille, who is the first known tapestry craftsman, wove this magnificent set containing ninety separate scenes divided among seven tapestries, measuring over five meters high and 143 meters long. Sadly, it was later used to protect fruit trees from the frost, and was even partly cut up to use as bed covering. This may be an extreme example, but as mentioned above, tapestries have numerous functions. Tapestries produced by religious houses in Germany, woven on small looms, were used as back cloths behind choir stalls or friezes (Fowle 1991, p.177).

A breakthrough in Gothic tapestries happened between 1515 and 1519, when Pope Leo X chose the



Fig. 27



Fig. 28



Fig. 29



Fig. 30

Fig. 27 Palazzo Davanzati, Florence, fourteenth century. (Alinari/Editorial Photocolor Archives.) / Fig. 28 Palazzo Davanzati, second-floor room. Florence, fourteenth century. (Alinari/Editorial Photocolor Archives.) / Fig. 29 A dining area surrounded by lengths of fabric, late fifteenth century. / Fig. 30 Linenfold panels of Paycockes House, West Street, Great Coggeshall, Coggeshall, Essex. Around 1500. / Opposite page, Fig. 31 The Spangle Bedroom at Knole House, bed curtains and fittings from early 17th century.

cartoons designed by Raphael to be woven in Brussels. “The Acts of the Apostles” designed by Raphael depicts a three-dimensional picture, rather than a flat surface. Realistic figures, a deep landscape and a low skyline added to the feel of depth and recession. This realism required a ten times diverse color palette compared to earlier examples (ibid., p.178).

Secular Architecture and Textiles

By the thirteenth century, civic buildings such as town halls, hospitals, inns, colleges and domiciles, took in some of the developments that existed in church architecture. A good example of textiles in secular architecture is seen in the Davanzati Palace in Florence (fig. 27). This palazzo is four stories high, located on the Via Rossa, the street of the wool merchants. Inside, there are hooks where fabrics used to be hung (fig. 28). There are also walls painted to appear like curtains, perhaps a medieval example of the “fake” trick-art decoration *trompe l’oeil*. In lesser rooms, geometric frescoes cover many partitions. Outside on the street, projecting hooks can be found, which were used to support decorative banners and tapestries for social events (Ball 1980, pp.163-166).

In a late fifteenth century painting, one can see a

fabric partition surrounding a dining table (fig. 29). Until furnishings became permanent, it was common for fabrics to move along with the people in buildings, to keep them warm (Krüger 2009, p.27).

An interesting textile-like work can be found in the later Middle Ages. Medieval wood panels were adorned with carved designs, and were called wavy wood, later named linen fold or parchment due to their close resemblance to the folds of fabrics or paper (fig. 30).

Windows were small and narrow during the Middle Ages, and were only covered with oiled or waxed paper. Later, windows were protected with internal wooden shutters.

Overall, the great cathedrals of this period brought dynamic movement into architectural space, and this space became gradually characterized with colors, lights and textures. Textiles also expressed more depth and richness. The following is a summarizing question presented by Ball (1980, p.217):

Yet it is important to note how hearth, cloistered bed, and sanctuary were provided – warmth, privacy, and spiritual asylum were part of life. With somewhat similar conditions today, can we provide an answer so suitable?

2.4 The Renaissance and Emergence of Interior Decoration

2

4

During the mid sixteenth century and eighteenth century, textiles developed to adorn interiors with more emphasis on luxury and comfort. The consumption of domestic textiles increased, dramatically changing home interiors. As paintings during this period often depicted the opulence of furnishings, the history of textiles is as accessible as ever.

The Renaissance

The great Gothic styles of the medieval period were soon replaced with a return to Classical architectural forms and principles (Gibbs 1994, p.9). The Renaissance, frequently related with Classical Roman architecture, first blossomed in Florence and other large cities in Italy already in the fifteenth century. After its peak around early sixteenth century, it spread throughout Western Europe.

In architecture, a new symmetry and harmony was evident, and interior decorations were perfectly proportioned. Interior space was significantly regarded, as it gradually became “the vortex for architectural organization” (Ball 1980, p.243). After the Renaissance, the relationship of the spatial form between interior and exterior needed to be taken into account.

Beds and wall hangings were no longer transported from one residence to another, and permanent furnishings were developed. The bed became the most expensive, prestigious piece of furniture in a household, and it was a symbol of wealth. Beds also required textiles in the largest quantity, as they were draped with “curtains, the canopy, valances for the head and foot board, and the coverlet and decorative pillow cases, as well, of course, as the sheets and blankets” (Petzold 1991, p.39). Until the end of the eighteenth century, the main bedroom was often used as a reception room; therefore the bed resembled a throne. The suspended draperies of medieval times evolved into being a canopy or tester, with a supporting structure of a headboard and corner posts. The bed curtains were often made of tapestry, silk velvet or brocatelle, which is a type of linen-mixed silk. One of the oldest beds surviving with its original trimmings is the King’s Bed at Knole House, from the early seventeenth century (fig. 31).

Tapestries also came to be used more as permanent furnishing. When

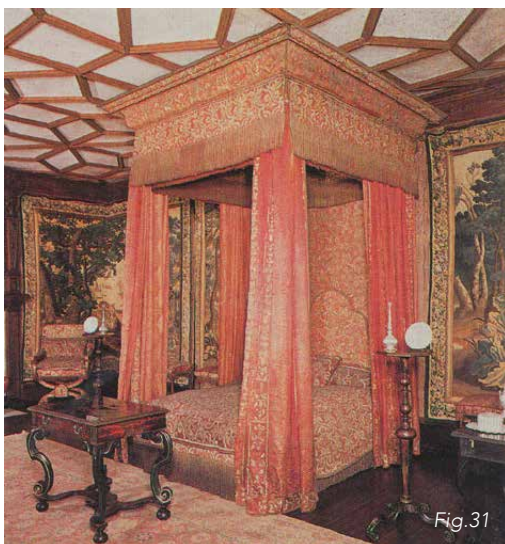


Fig.31

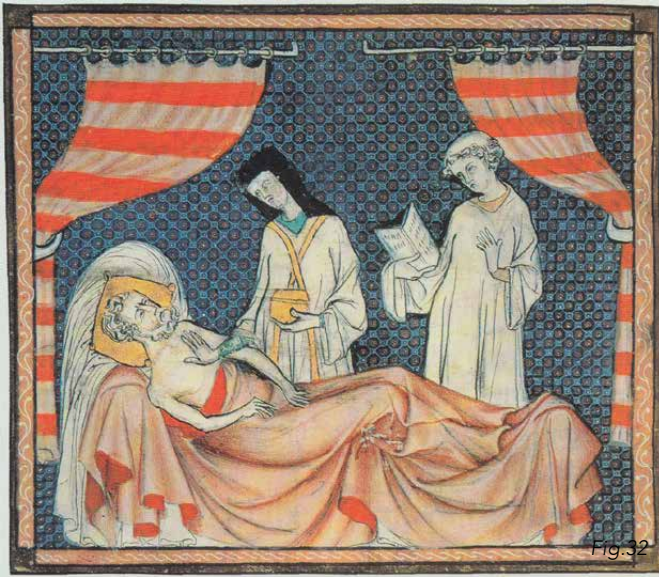


Fig. 32

new houses were built, sometimes a room was designed to be a specific size to take in a set of tapestries, rather than the other way around. For example, the Great High Chamber at Hardwick Hall was planned especially for the eight pieces of Brussels tapestry, bought in 1587 (Clabburn 1988, p.83). Renaissance borders of tapestries became wider than their precedents. Magnificent examples of the Renaissance are the Raphael tapestries, commissioned by Pope Leo X for the Sistine Chapel in 1515. It was to complement the vigorous ceiling by Michelangelo, and the tapestries' significance increases with a holistic consideration of the interior architecture. Their candle-tree-like borders grew upwards, portraying the architectural painted pilasters. The tapestries were designed so that "in both form and lighting they strengthened their several positions in the chapel and indeed carried design elements consecutively from one hanging to another" (Ball 1980, p.294). This continuous movement perhaps guided the viewers through the architectural space, both functionally and aesthetically.

Besides tapestries, paint and fresco began to adorn the walls. This is evident in French interiors of the period, where ceilings were also heavily painted. The first wallpapers were also possibly created in France.

The developments in textiles in general are also worth mentioning. By the beginning of the Renaissance, there were more asymmetrical designs and there was movement in the fabrics. The end-use of the fabric started to be taken into account as well. In England, the emigrated Dutch and Walloon weavers introduced a rich variety of weaves, and lighter textiles called 'New Draperies' were developed.

Window drapery came after the furnishing of beds and walls. The glazing of windows became standard in town houses from the late sixteenth century, but even then it was not common. Homes without glass had a wooden frame that would be filled with cloth or paper, sometimes



Fig. 33

with horn. However, other forms of drapery have acted as partitions to divide the large spaces of the great halls.

The earliest forms of curtains were only looped or pulled to one side of the window, and were not in pairs. They were suspended on iron rings that were directly sewn onto the fabric or by fabric tapes (fig. 32). Curtains made out of thin material such as sarcenet or taffeta may have been hung over the window during the day as well, acting as a screen (Clabburn 1988, p.133). Early French and Italian curtains were more elaborate compared to their English counterparts, and were hung in pairs. They were quite narrow and did not reach the floor (Gibbs 1994, p.19). Curtains were often seen on doorways for insulation, such as the portières that were used in France in the latter half of the sixteenth century.

The Baroque

By the early seventeenth century, the Renaissance evolved into the Baroque style in Italy. Architecture was given a new direction, and spaces were organized in three-dimensional extension. Textures became a prominent element in design. The new role of light in Baroque architecture added theatricality to the buildings.

In Italy, textile designs became more complex. Three-dimensional velvets combining different piles, complicated background weaves, and elaborate brocatelles created sculptural effects. Patterns were no longer symmetrical and clear contrasts in tone led to dramatic effects. Tapestries now had exceedingly wide borders, incorporating architectural framings (Ball 1980, pp.334-335).

In France, the first all-round interior decorator and architect, Charles Le Brun was commissioned the most important buildings and interiors of the day. He was part of the famous trio, along with architect Louis Le Vau and

From left to right, Fig.32 Early method of suspension, with metal rings sewn directly onto the curtain. These were then slotted onto a metal pole with a hooked end to prevent the curtains from sliding off. / Fig.33 Savonnerie carpet by Charles Le Brun, France, seventeenth century. Wool. Metropolitan Museum of Art, New York. (The Metropolitan Museum of Art, Rogert Fund, 1952.) / Fig.34 Southside House in south London, built in 1665.

landscape architect André Le Nôtre. They first collaborated in the designing of the chateau near Melun, known as Vaux-le-Vicomte, meaning “the vales of the viscount” (ibid., p.346). Before these collaborations among multiple disciplines, the interior work was considered separate from architecture, but in the mid-seventeenth century, designers came together to work as an organization. The king controlled the organization called Bâtiments, and beneath him worked the minister of state, giving orders to the chief administrative officer of the organization (ibid., p.353). After his work at Vaux-le-Vicomte and the royal palaces, Le Brun was called to the Bâtiments when the planning of Versailles was initiated. In his designs, he favored to use French arabesque decorations. This included the decorative motif of the *lambrequin*, which was a fold or short drapery. Le Brun also designed more than eighty tapestries. In a large carpet that he designed, a close analogy between architecture and carpet design is visible (fig. 33). In France, the ceiling borders of the architecture were referenced when designing the frame of the carpet.

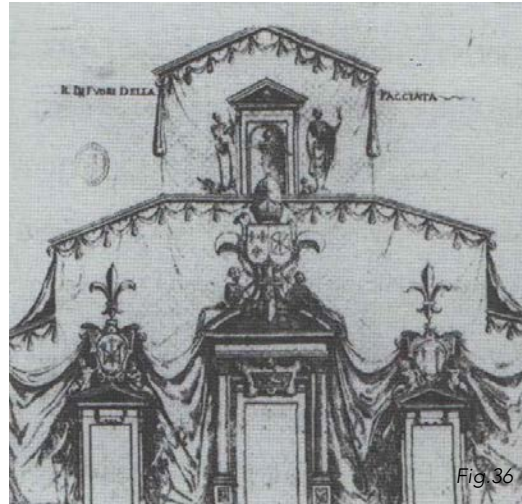
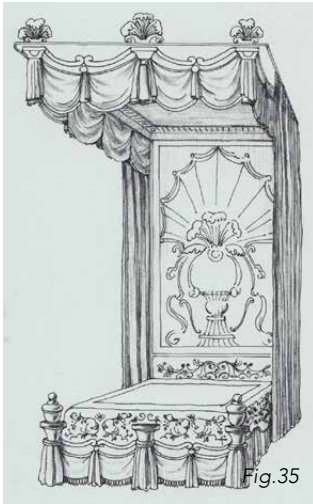
Baroque homes featured hangings that covered the entire surface of a wall (fig. 34). The tapestries were cut again to fit the dimensions and the other elements that adorned the room. Furthermore, mirrors and easel paintings became more common, and were hung against these wall coverings. Hangings were changed according to the season; tapestry or velvet for the winter, and lighter silks for summer (Gibbs 1994, p.29). Architects such as Le Brun were not common, and usually the upholsterer designed unified rooms, as it became fashionable to coordinate the interiors and exteriors of buildings. Although the name resembles upholstery fabrics, in the 1600s they mainly arranged textile wall coverings. The upholsterer was at the height of his power in the eighteenth century, organizing all the interior furnishings, including the supplying of all the necessary fabrics. He even made the furniture in his



workshop.

During the seventeenth century, the manufacture of wallpapers developed. The *papiers veloutés*, or flock papers, were made so that a “pattern was hand blocked in varnish on paper. Powdered wool which was then sprinkled over the paper adhered to the varnish to create a raised pattern” (Ball 1980, p.370). However, the use of wallpaper was still restricted until the eighteenth century, when they became manufactured in rolls.

Curtains and draperies developed greatly during the seventeenth century. More light came in through the new sash windows that were introduced. They also added a stronger sense of symmetry, both in the interior and the exterior, therefore bringing more attention to the decoration of windows. This led to the use of paired curtains, and beds, curtains and chairs were similarly decorated in dark, rich colors. One of the earliest paired curtains were used in the Ham House in London in 1654, but they generally became popular in France in the 1660s. The pull-up curtain, which was pulled up by cords to hang as festoons or swags, was invented during the century as well, but was used in the wealthiest homes. The earliest blinds appeared in the early seventeenth century, made of fabric, cotton or silk, and were often oiled for strength. Also in grander houses, white silk blinds also came into use from the middle of the century. Holland matting and unlined Indian calico was used as well, protecting the



Left to right, Fig. 35 An example of a 17th century *lit à la duchesse*, or angel bed. The "flying" canopy is suspended by cords attached to the ceiling and so does not require endposts. / Fig. 36 Temporary veiling of the Basilica di San Lorenzo for the funeral of Enrico IV, Florence, Italy, 1610.

furnishings from the sun. Gibbs mentions that painted calico was pleasant to the eye when the sunlight shined through it (1994, p.42). Sashes also acted as sun-screens.

Beds were still a prominent element in the interior. Beds known as French beds had no posts, and were completely covered by hangings, which hung straight from the rails of the wooden frame by nails. "Flying" canopies were developed – domed testers had a canopy that suspended over the bed by cords attached to the ceiling (fig. 35). As the century progressed, beds were moved from the corner of the room into the center of the wall. Beds were growing taller; a bed made for Queen Anne at Hampton Court Palace had a three meter high frame with silk hangings (Gibbs 1994, p.37). Two, four or six curtains were used for bed hangings, but sometimes fabric was simply draped around the bed. Houses were better built by this time, and lighter fabrics such as Chintz, or printed calico cotton, replaced the heavy tapestry curtains. Chintz were also favored because they could be washed and had color fastness qualities.

Textiles were also used in exteriors. Their relation to death had not ended in ancient times; in 1610 in Florence, Italy, the Basilica di San Lorenzo was temporarily covered for the funeral of Enrico IV (Krüger 2009, p.37) (fig. 36).

The Rococo and Neoclassicism

- The Rococo and the Palladian Revival

During the early to mid 18th century, two major styles emerged: one being the Rococo and the other the Palladian revival. They originated from different parts of Europe, and could have not been more of the opposite.

The Rococo began in Paris and spread throughout Europe. The Régence period between 1715 and 1723, when Philip, duke of Orleans, was Regent to the infant

Louis XV, was a time of transition. The early Rococo developed at this time, when the freedom of expression flourished and frivolous, exuberant designs emerged. Light was an important element, and mirrors were placed to reflect the sunlight and candlelight (Gibbs 1994, p.51).

Interestingly, a close relationship between the fashion and interiors of Rococo is apparent. For example, a new energetic dance introduced by the French queen required the ladies to pull up their dresses. This idea led to the pulling up of bed and window treatments (ibid.). Like the fashion of the day, interior fabrics became lighter and more frivolous, especially in France.

On the other hand, the Palladian revival was mainly an English style. Balance and symmetry were key to the interiors. Walls were often painted, but also wallpaper, dark silk or velvet was applied.

During this period, new types of bed canopies were introduced in France, and spread to other parts of Europe as well. The *lit à la turque* was placed parallel to the wall, and had a small canopy or half-tester from which the drapery fell over the ends of the bed (fig. 37) (ibid., p.61). Another type was the *lit à la polonoise*, which had a dome attached by rods from the corners or the bed or from brackets connected to the wall behind (fig. 38) (ibid.). Bed hangings became lighter than their precedents, and a greater sense of movement was apparent in the fabric designs and also in their way of use. However, even though they were "light," additional decorative elements increased, "with swags, bows, knots, tails and complicated arrangements of rings and pulleys, making the bed into a whirl of drapery, as eye-catching as it was dust-catching" (Clabburn 1988, p.111). Designs differed according to the emphasis on either the perspective of the visitor or the sleeper (ibid.). In the *Workwoman's Guide* in 1838, eleven different kinds of beds are illustrated: "the Four-Poster, Tent, Camp, Half-Tester, French Pole, French Arrow, Canopy, French Block,



Fig. 37



Fig. 38



Fig. 39

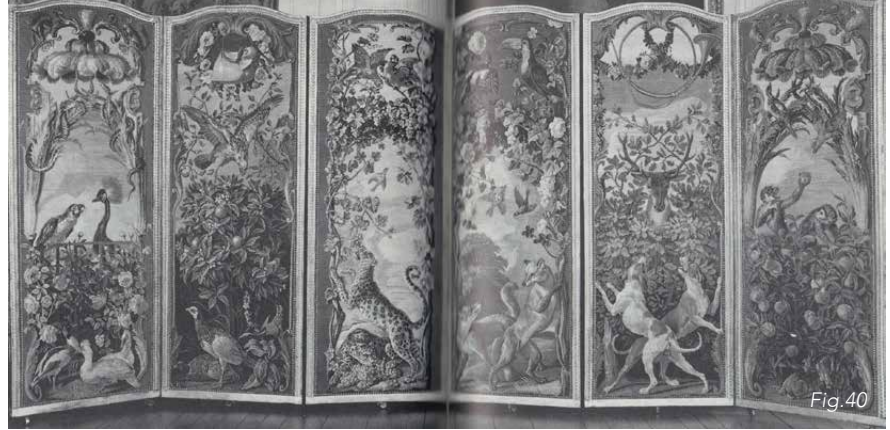


Fig. 40

Left, top to bottom, Fig. 37 An 18th century *lit à la polonoise*. / Fig. 38 A *lit à la turque*. / Fig. 39 Reconstructed case curtains for the State Bed at Dyrham Park. / Above, Fig. 40 Screens with panels woven at the Savonnerie factory, after designs by Desportes, 1719. Waddesdon Manor.

Turn-up, Stump and Trestle. All except the last two have some form of drapery” (ibid., p.111-113). Drapery was now an essential element for the middle and lower classes as well.

Furthermore, the most elaborate beds were so precious that extra curtains were hung on separate rods, protecting the bed inside (fig. 39). Although the extra layer helped the furniture and furnishings to last, people could seldom see the bed itself.

By the middle of the eighteenth century, window curtain designs became more important than ever, but were still of less interest compared to the bed curtains. Although elaborate window curtains, perhaps quilted, would have been a warm solution, it was always so that the bed curtains were done very elaborately, sometimes even embroidered.

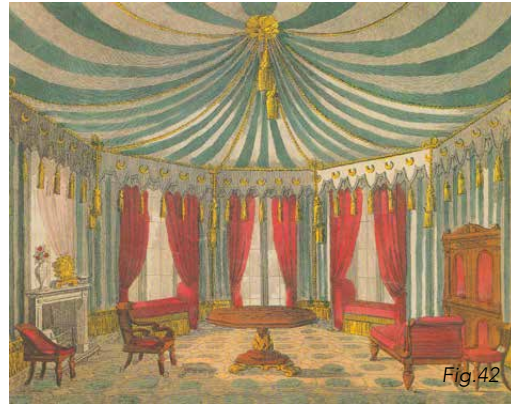
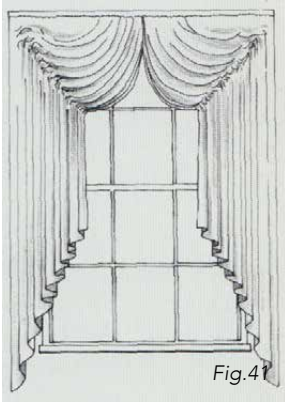
Various types of screens were used throughout the years, but some of the most superb examples are from the eighteenth century. There were large six- or eight-fold screens, firescreens, pole screens, banner screens and hand screens. They kept out the draughts and helped to preserve delicate surfaces. Large draught screens were often covered with knotted tapestry, as the early eighteenth century example from Waddesdon shows (fig. 40).

-Neoclassicism

During the late 18th century, Neoclassicism developed as a counter-reaction to the Rococo style. It was more rational and elegant, characterized by simple forms and flat decorations, referring to the Greek and Roman ornaments. In England, it was a natural development from the Palladian revival (Gibbs 1994, p.69).

One of the most influential architects of Neoclassicism was Robert Adam from Scotland. As there were few new building projects at that time, Adam worked also as an interior designer in refurbishment projects. He often used classical motifs in painted decoration and plasterwork. This decorative detail was important in neoclassical interiors, and they diminished the original architectural features. Interiors were more coordinated than ever (ibid., p.79). Furthermore, the colors in interiors began to be selected according to the orientation of the room; cool tones were recommended for rooms facing south, and warm tones for the opposite (ibid., p.83).

With the rise of new professions such as cabinet makers, carvers,



Left to right, Fig. 41 Italian-strung, or reefed, curtains. / Fig. 42 Tented walls and ceilings of Empire style interiors. / Opposite page, Fig. 43 A French "military-style" bed. / Fig. 44 Tent Room. Karl Friedrich Schinkel. After 1826. Schloss Charlottenhof (Potsdam, Germany). / Fig. 45 A French style bed.

gilders and painters, the job of designing beds was not of the upholsterer any longer. Therefore, hangings were less emphasized, generally having a lighter look. In eighteenth century America, curtains gradually shortened in length and could be pulled up with a cord system to show the more important carvings on the bedposts.

In curtains, a major innovation was the full cord-and-pulley system, often referred to as French rods. This allowed curtains to be opened and closed with more convenience and less damage to the fabric. By the 1780s, it became popular to have draperies or pelmets above windows with French-rod curtains. There were also Muslin sub-curtains which protected furnishings from sunlight, and screens reminiscent of sashes, painted green, were attached to the bottom half of the window for privacy. More and more curtains developed in a functional direction. More decorative additions were the reefed or Italian-strung curtains, which had diagonally strung cords that pulled the curtains apart (fig. 41).

Overall, although simplicity became more apparent in neoclassic style, fabrics were still utilized in multiple ways so as to soften the architecture.

- Regency and Empire Styles

Between around 1790 and 1840, a style called the Regency style developed in England. It was essentially still neoclassical, but with some apparent differences. In continental Europe, the late-neoclassical style was named the Empire style. It began in France in the 1790s. In both styles, Classicism was recognized in a purer, simpler form, with less decoration compared to the previous styles. The designers were inspired mainly by Ancient Greece and Egypt (Gibbs 1994, p.99).

In France, the architects Percier and Fontaine realized many designs in the Empire style, which were copied all over Europe. They collaborated in the redesign of Château

de Malmaison, and after this work Napoleon appointed the two to work as architects, interior decorators and designers, until his resignation. In the book *Recueil des Décorations Intérieures*, Percier and Fontaine were the first to use the term "interior decoration" (ibid., p.101).

Percier and Fontaine often created tented structures in their Empire interiors, also seen at Malmaison (fig. 42). This was because Napoleon favored military elements, resulting in "*le style héroïque*," where fabrics were used on both walls and ceilings. Napoleon is said to have been so impatient that he needed things to be done very quick, and therefore textiles were used to quickly create new spatial effects. These indoor tents, or "room-in-rooms," later appeared in England, in materials such as brocades, silks and chintzes. There were also "military-style" beds, with draperies that resembled a tent shape (fig. 43). They were also tent-like in that they were often portable. Another tent room example is found in Charlottenhof Palace in Potsdam of 1830, designed by the prominent Prussian architect Karl Friedrich Schinkel (fig. 44). Bed drapery, however, was mostly much simpler compared to earlier periods. A typical style was "the French Empire method of placing the bed along the wall with a centrally mounted canopy supporting curtains or draperies that trailed over the curved ends of the bed" (fig. 45) (Gibbs 1994, p.118).

Curtains, on the other hand, were deeply layered. Outer curtains, under curtains, muslin curtains and sunblinds were combined, using poles or covered with a deep valance. The poles were usually suspended from a curtain cornice "to give architectural impact" (ibid., p.120). Besides valances, there were pelmets and swags that defined the top of the curtaining. These additions were often more important than the curtains themselves. Portières on doors were often double-sided, so that each side could be coordinated with the room it faced (Gibbs 1994, p.149).

In the early 19th century, windows became taller and narrower, and the pull-up curtains became too heavy for them. Therefore, lighter, draped curtains hung singly or double were preferred. Under-curtains, or sub-curtains, were either fixed to one side of the window or drawn to block excess light. There was more variety in blinds; white roller blinds, slatted blinds, chintz blinds and updated forms of sashes, and some were made in material that matched the curtains (ibid., p.120). In 1847, Thomas Webster in England referred to sunblinds made of “linen painted as transparencies” (Clabburn 1988, p.147). In his book on household management, he writes: “some are extremely beautiful, representing scenes in nature, either landscape, interiors of buildings, or arabesques, and are particularly convenient when it is desirable to exclude the view of disagreeable objects” (qtd. in ibid.). These blinds seem to have depicted three-dimensional images, which were aesthetically preferred than the actual view from the window. Another example existed on the wall of the King’s Room at Oxburgh, which was termed as a blind “painted as a transparency” as well (ibid.). External blinds were also used, made of canvas or were frame-and-lath blinds, which had slats and were adjusted with a knob in the frame (Gibbs 1994, p.120).

Although the layered window treatments were carefully designed according to a proportional system, and the cutting was done sustainably to avoid as much waste as possible, they were unhygienic and could easily catch fire, therefore causing various problems in the end.

Overall, this period brought forth an abundant variety of decoration in interiors, and textiles were creatively applied in numerous ways. The efficiency of industrialization and emphasis on hygiene that followed meant no more lavishness after the late nineteenth century, and this perhaps has limited the creativity in application methods.

Developments in material have transformed textiles into new levels, and many are perfectly functional by simply placing one flat layer of it. However, again, textile designers and also architects are draping, pleating and layering materials, not only to add more depth to space, but to also utilize their properties in sustainable ways.

Therefore, when one looks back towards times before the eighteenth century, he or she may be able to discover intriguing spatial textiles, which can be developed into modern solutions with help of present-day innovations.

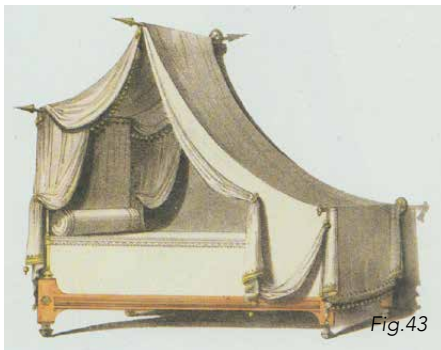


Fig.43



Fig.45



Fig.44

2.5 Industrial Revolution and the Arts and Crafts Movement

Industrialization and the Gothic Revival

Dramatic changes in both domestic and city scale began in the latter part of the eighteenth century. The Industrial Revolution was a time of technical developments and innovations; production was mechanized and costs were lowered down. As production processes became more and more efficient, textiles were popularized among all peoples. They were no longer symbols of wealth and social prestige, but more of pliability and practicality. By the late eighteenth century, the production of tapestries decreased as people's tastes changed, and wallpapers manufactured in greater amounts began to be frequently used (Fowle 1991, p.180). Synthetic dyes started to replace natural dyes by the 1850s. Simultaneously, developments in mechanization were blamed to have caused the decline in public taste in art and design. This was most speculated at the 1851 Great Exhibition in London. Some people saw it as a great success, but others claimed it as a total crisis.

A counterpart of the new designs of industrialization looked back towards the Middle Ages. The Gothic Revival was already underway in Britain and America by the 1840s (Williams 1991, p.64), and was led by the architect Augustus Welby Northmore Pugin (1812-52). Pugin and also John Ruskin's arguments were influential throughout the Gothic Revival movement, stating that "(t)ruth to nature, truth to materials and a just society" were essential for good art and design (Woodhead 1991, p.74). Pugin further believed that "all ornament should consist of enrichment of the essential construction of the building" (qtd. in Clabburn 1988, p.68).

Furthermore, the discussion of ornament was further investigated by architect Owen Jones, especially in his publication *The Grammar of Ornament* of 1856. He

anticipated the concept of "pattern," a structure consisting of repetitive elements. They were flatter than the previous three-dimensional drawings, and Owen believed that they were appropriate for the textile industry.

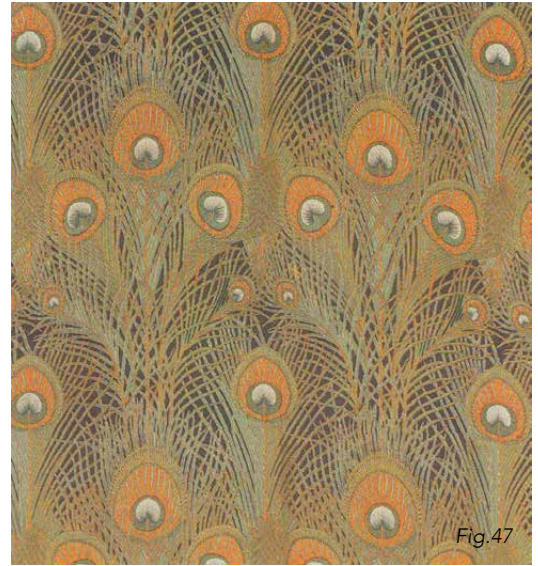
These ideas of reforming design also spread to the home. During the late nineteenth century, Mrs. Haweis wrote books and texts about home interiors, and in *The Art of Beauty* she anticipated that "all architects would ... design all parts of a house – wallpaper, furniture and textiles" (Clabburn 1988, p.64). Already, more conceptual textiles were expected to be integrated into architecture.

This integration was also supported by the idea of the "total work of art," or *Gesamtkunstwerk*, which was later applied by many of the modernist designers. According to Troy, this "synthesis of art and life as a condition of modernity" was mentioned as early as 1849 by Richard Wagner (1813-1883), in his essay 'The Art-Work of the Future' (*Das Kunstwerk der Zukunft*) (2006, p.19). Wagner envisioned a unification of the arts that aimed for a common purpose, thus for the general public as well.

The Arts and Crafts Movement: William Morris

Pugin's ideas and also the essence of *Gesamtkunstwerk* are most recognizable in William Morris (1834-1896), who reformed the applied arts and initiated the Arts and Crafts movement. Through his teaching and his works, Morris summed up the feelings of those who opposed the negative effects of industrialization (Rowland 1973, p.10). He did not reject the designs of the products themselves, but was more concerned of a larger problem that they would weaken human sensibilities and the quality of society.

Morris valued craftsmanship and the pleasure acquired through labor. He designed many textile fabrics, and the



involvement of friends and family were essential in his works. For example, his wife Jane Burden executed his designs for the embroidered hangings in their home. To Morris, architecture was a collaborative work, and these close relationships led to the formation of his firm in 1861. It was initially named Morris, Marshall, Faulkner & Co., later reorganized as Morris & Co., and was founded in London. The embroideries executed by relatives and friends were the first textiles produced by the company, and their success in international exhibitions led to other commissions, from stained glass windows to wall hangings and screens. Morris' designs were influenced by antique motifs and patterns, from Islamic, Persian to Italian, and he flattened and stylized them to create rhythmic patterns. His repeats were hidden ingeniously, and their structures, with an organic sense of growth, led the viewer's sight along the surface (fig. 46). At the same time they were very practical and sensible. Morris reached a new level in textile design, contributing not only to building interiors, but also to better life in general.

Influence of the Arts and Crafts Movement

Morris' ideas spread across the world. In America, where draped hangings and curtains were still used everywhere – from windows, doors, beds, chimney breasts and even pianos – until the mid nineteenth century, Arts and Crafts became known as the Craftsman style. The dark, stuffy rooms became problematic, and lighter, simpler fabrics were introduced. Beds were simplified, and the actual quality of fabric design was valued.

Besides the products of Morris & Co., the textiles of Liberty & Co., established in 1875, were popular and successful. Arthur Lasenby Liberty spread Eastern style "art fabrics" to the public, and cross-cultural influences escalated in the field of design (fig. 47).

Morris' reform inspired other designers to form guilds like those of medieval craftsmen. The first was Century Guild formed in 1882, led by Arthur Heygate Mackmurdo. Mackmurdo was also an architect who designed textiles, but his designs leaned towards the Art Nouveau style, explained in the following section.

Charles Francis Annesley Voysey, friend of Mackmurdo and also an

Left to right, Fig.46 William Morris, *Evenlode*, printed chintz, 1883. Victoria and Albert Museum, London.
/ Fig.47 'Peacock Feather' design by Arthur Silver, exhibited 1887: it later became almost a logo for Liberty's.



Fig. 48



Fig. 49

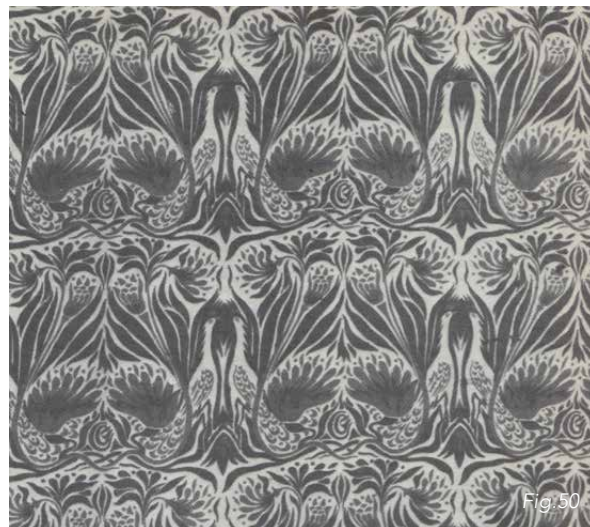


Fig. 50

Art Nouveau

English architect, designed simple furniture, wallpaper and textiles in the Arts and Crafts style. They were perfect applications for homes and became a model for British interiors as we know today. He also supported the stylization of naturalistic elements, and further developed the purifying process of the Arts and Crafts movement. Voysey's sophisticated, flattened designs enabled rooms to be regarded once more "as volumes of space enclosed by walls" (Rowland 1973, p.18) (fig. 48). During the Victorian era, the simple concepts of form and space had not been worth relevant discussion.

The most important guild was the Art Workers' Guild formed in 1884. Their members were against the conventional ways of the Royal Academy, and created the Arts and Crafts Exhibition Society in opposition. Their ideals spread with their exhibitions and publications, and their influences fostered changes in design, leading to the initiation of Modernism in the twentieth century.

In America, textile designer Candace Wheeler was influenced by Morris and became a leading figure in the field of American textile arts. In 1879, she established Associated Artists with other designers, working in a similar way to Morris & Co. (Woodhead 1991, pp.81-82) (fig. 49). The group undertook several large commissions, including the refurbishment of the public rooms of the White House.

Last but not least, the leading exponent of Arts and Crafts in America was the architect Frank Lloyd Wright. In contrary with the movement's purists, Wright integrated mechanization techniques with the Arts and Crafts style, and developed his own unique approach, which is discussed in Chapter 2.6.2.

Following the Arts and Crafts Movement, there were various stylistic developments in different parts of the world. Two distinct versions of this "new style" are termed Art Nouveau and the Glasgow Style, and both had substantial effects on both architecture and textile design.

The Art Nouveau style was initiated in France and Belgium, and was most active between 1893 and 1910 (Gent and Aubry 2001, p.12). It began with reference to arabesque and naturalist decoration, and more geometric designs were developed later on.

As mentioned above, A. H. Mackmurdo was one of the first Art Nouveau designers. Features first used by Mackmurdo became common characteristics of Art Nouveau, such as his signature "whiplash" motif (fig. 50). Hector Guimard, who designed the Paris Metro stations, and Victor Horta of Belgium are also frequently mentioned as prominent architects of this style.

Art Nouveau was demonstrated with sinuous, elegant lines that guided the eye along different organic movements, integrating the different elements in sight. These flowing lines are similar to what Morris had executed in his designs, but now they carried an additional emotion and tension (Rowland 1973, p.28). The strength of the style unified entire interiors and its elements, and details were also apparent in the exterior. Perhaps there were no actual "spatial textiles" in Art Nouveau interiors. However, Rowland asserts that volumes of air between the structural elements were consciously designed (ibid., p.31). In Art Nouveau, tangible materials, which were elegantly shaped, created a movement within the voids, therefore enhancing the spatial experience in an abstract way.

This use of visual elements to create spatial tensions is



Opposite page, left to right, Fig.48 Charles Francis Annesley Voysey, *Poppies*, printed velvet (plush) for furnishing, 1900-05. Francesca Galloway Collection, London. / Fig.49 'Consider the Lilies of the Field', curtain designed by Candace Wheeler. Mixed media, embroidered and painted. / Fig.50 Arthur Heygate Mackmurdo, fabric, design, 1884. / Top to bottom, Fig.51 Henry Van de Velde, *Engelswach; La Veillée des Anges (The Angel's Watch)*, 1893. Wool appliqué and silk embroidery. / Fig.52 Translucent lace curtain in La Pedrera apartment building, designed by Antoni Gaudí, Barcelona, Spain, 2007.



also apparent in architect Henri Van de Velde's depictive work (ibid., p.36). In his tapestry *The Angel's Watch* of 1893, the strong lines unify the entire image (fig. 51). With this work, Van de Velde, who was originally a painter, turned to the new medium of textiles. Troy indicates that "[t]he work is a physical manifestation of the contemporary discourse involving the unification of fine and applied art" (2006, p.21). Van de Velde was actually one of the earliest designers to embrace and develop the Arts and Crafts Movement in Europe.

Art Nouveau took an original direction in Barcelona, with the influence of the Catalan revival. Architect Antoni Gaudí created many works with strong influence of Art Nouveau, and many of his grand projects were realizable due to his patron Eusebio Güell Bacigalupi, who was a textile manufacturer. Gaudí himself is known to have designed textiles as well, such as the lace curtain – again with strong curvaceous lines – in the La Pedrera apartment (fig. 52).

The Glasgow Style

The second style succeeding the Arts and Crafts Movement was situated in Scotland, as it did not directly follow the English way. Young designers in Glasgow fused the Scottish tradition with the emerging new style, the leader being Charles Rennie Mackintosh. According to Rowland, Mackintosh's work brought nineteenth century architecture and design towards the twentieth century as close as it could get, without actually becoming its component (1973, p.50). Mackintosh worked with various crafts besides architecture, and he was actually more successful with his textile designs than his early architectural designs. Although he designed fabrics for mass production in two textile firms, Foxton's and Sefton's, he usually designed fabrics for specific projects such as architectural commissions, where he had specific ideas of their use in mind (Billcliffe 1982, p.12). He worked closely with his wife Margaret, who also designed

many textiles. Together they produced distinct designs featuring geometric flowers, possessing clear structures like those of architecture (fig. 53). The Mackintoshes also worked in the *Gesamtkunstwerk* style, designing unified interiors.

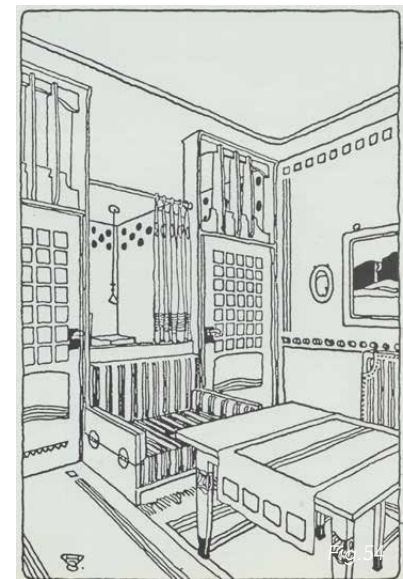
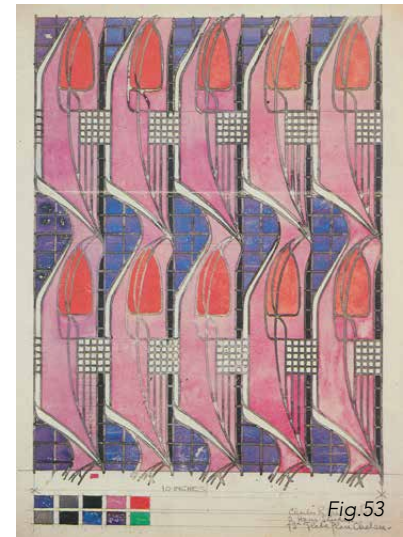
Vienna: The Secession and Adolf Loos

Mackintosh's designs were influential in the development of the Viennese Secession. This group of artists and designers – like all the other artists and designers of the era – reacted against the historicism of the time. They split from the Künstler Wiens, the Vienna Society of Fine Artists, as the Secessionists. Led by architect Otto Wagner, “they saw the integrating tendencies of the new art primarily as an effort for a better human environment and as a social challenge” (Rowland 1973, p.60). Wagner himself strongly believed that “form could only be a result and not a starting point of the creative process,” and his ideas bridged the Art Nouveau of the nineteenth century to twentieth century modern architecture (ibid., p.74).

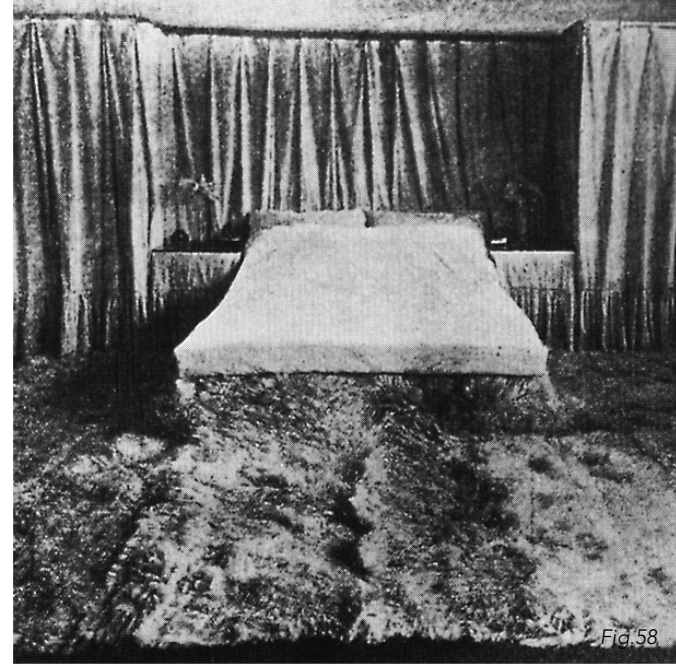
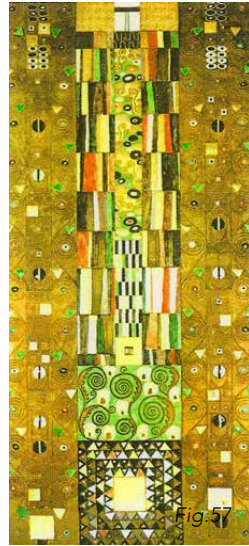
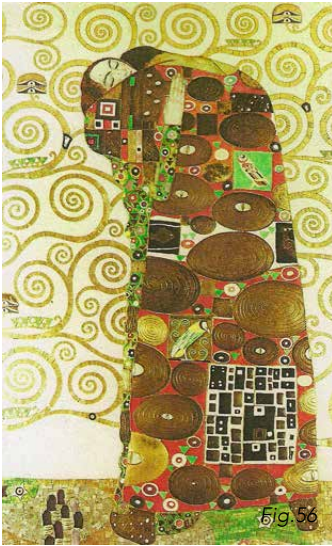
A noteworthy architect of the time is Josef Hoffmann. His clear design concept is evident in a design for a bed-sitting room in 1898 (fig. 54). Here, simple, geometric patterns are abundantly used, but in ways that highlight the individual items in a spatial context. Square patterns adorn square elements, and the curtain designs and open screens anticipate the space beyond. An obvious example is the tablecloth, where rectangles and squares are placed so as to emphasize the horizontal and vertical planes of the table. In Hoffmann's unique designs, the spatial relationships between patterns and interiors were greatly emphasized. Around the same time, in 1897, German architect August Endell brought up the discussion of design in architectural space. He recognized the emotional effects of architecture, and emphasized how proportions and divisions of areas, for example windows, affect our impressions. Endell's approach is different from his predecessors, who would have mentioned the importance of ornaments and historical relations (Rowland 1973, p.65).

Hoffmann's attention to “a unity of structure, space and surface texture” develops in the Palais Stoclet in Brussels in 1905 (ibid., p.67) (fig. 55). The building was enhanced by his specifically designed furniture, and also by the mosaic murals designed by the fellow Secessionist Gustav Klimt (fig. 56). Here, Klimt used various patterns to create relationships between the shapes in the image. In the end panel, the square elements correspond with the designs of Hoffmann (fig. 57).

The architect Adolf Loos had somewhat different and more complex ideas than the other Viennese architects. He wanted to remove architecture of all non-architectural elements, so that functional objects serve their functions with nothing more than their meant shapes and structures. Therefore, it is understandable that he had little concern over the textiles he used, and the clients, not Loos, chose for instance items such as carpets. Surprisingly, however, textiles dominate the bedroom he designed for his wife Lina (fig. 58). There is a wall-to-wall carpet of pale blue on the floor, on which a thick rug of Angora rabbit is laid. The rug even continues onto the bed. White curtains in “Batist rayee” are hung on all the walls, up till the height of the door. These textiles are not decorative ornaments, but more of a “material ornament,” as Andrews describes (2010, p.444). Loos had a distinctive view towards primitive textiles, and he explains in his “The Principle of Cladding” of 1898 (qtd. in ibid.):



Top to bottom, Fig.53 C.R. Mackintosh, *Tulip and lattice*. Pencil and watercolour. / Fig.54 Josef Hoffmann, design for bed-sitting room, 1898. / Fig.55 Josef Hoffmann, Palais Stoclet, the large dining room. Brussels, 1905.



Above, left to right, Fig.56 Gustav Klimt, *The Fulfilment*, 1905-1909, mosaic for Palais Stoclet. / Fig.57 Gustav Klimt, *Knight*, mosaic for Palais Stoclet. / Fig.58 Adolf Loos, Lina Loos' bedroom, 1903. / Below, Fig.59 Otto Wagner, Rumbach Street Synagogue, Budapest. / Fig.60 Otto Wagner, Majolica House, Vienna, 1898.



That is the correct way, the logical way architects should go about their business. That was the order in which mankind learned to build. In the beginning we sought to clad ourselves, to protect ourselves from the elements, to keep ourselves safe and warm while sleeping. We sought to cover ourselves. Originally consisting of animal furs or textiles, this covering is the earliest architectural feature.

Here, we can see the clear influence of Gottfried Semper's theories in textile and architecture. Semper's debates influenced other Viennese architects as well, such as Otto Wagner and Josef Hoffmann (Houze 2006, p.295). Not only did they affect actual textiles such as of Loos' bedroom, they also affected the exteriors of architecture. Wagner's "dressed" buildings had textile-like façades, one of his earliest examples being the Budapest Synagogue (1870-3) (fig. 59). An even clearer reference to textiles can be seen in his Majolica house of 1898 (fig. 60).

It can be concluded that textiles were of great interest in Central Europe during this time. In fact, the main theme of the Eighth Secessionist Exhibition in 1901 was interior design and furnishings, rather than the traditional fine arts. Houze writes that Semper was greatly interested in textiles due to the developments and failures in the textile realm of his day, as it also allowed for further improvements (ibid., p.299). Similarly, architects in Central Europe were keen on textiles, since they represented the warmth of the living environment. As spaces transformed, its elements, such as textiles, also needed to take the next step. Therefore, textiles began to be applied in innovative ways – both conceptually and realistically – with reference to ancient spatial textiles during the late nineteenth century.

2.6 Modernist Architects and Textiles

2.6.1 The Bauhaus

Emergence of Modernism

In the beginning of the twentieth century, significant changes in both architecture and textile design occurred. The new ideas of modernism, or the international style, as the name suggests, spread throughout the world, and shaped much of society throughout the century. The Bauhaus, which was active from 1919 to 1933, greatly contributed to this movement, and is highly relevant in this context due to the simultaneous existence of the textile workshop and the architecture department.

Before the establishment of the Bauhaus, the Deutscher Werkbund was formed in 1907, consisting of German designers, craftsman, architects and industrialists (Rowland 1973, p.117). They aimed to bring together the artist and manufacturer so as to solve the problems seen in standardization, but not with strong emphasis on handcraft like the Arts and Crafts movement. The Deutscher Werkbund's experiments and progressions with industrial materials are observable in their 1914 exhibition. Glass was a prominent material, used in both functional and aesthetic ways. The Model Factory designed by Walter Gropius and Adolf Meyer was one of the boldest examples of the time, with its enveloping glass wall (fig. 61). The conventional façade ceased to exist; instead a transparent layer wraps around the inside spaces, and continues along the curves of the staircase. The Model Factory exemplified the architect's new role of creating innovative concepts out of industrial subjects.

In 1914, Walter Gropius was suggested by Henri Van de Velde to be the head of the Weimar School of Design. Five years later, this was confirmed and Gropius issued the manifesto and program of his new school, the "Bauhaus." The Bauhaus was not an institution that strived to invent a new style; Gropius was determined to examine the creative

collaboration among different disciplines and to influence twentieth century design in a positive way. The Bauhaus' philosophy was that "form follows function," and this idea led to their many design solutions, which is also visible in its textile productions.

The Weaving Workshop was the only workshop that extended across the entire life span of the Bauhaus, until its closure in 1933. Johannes Itten, who taught the preliminary courses, and Paul Klee, once the Form Master of the textile department, were both influential in the students' works.

However, the actual weavers, of course, are the ones who skillfully utilized textile techniques to create new, modern fabrics. Gunta Stölzl was one of the leading figures in the Weaving Workshop, and she became the one and only female Bauhaus master (fig. 62). At first, textiles and also their women makers lagged behind in the development of the other workshops. Stölzl herself criticizes that the works were "too autocratic" in the early days (Bourneuf 2009, p.222). However, Stölzl later divided the Weaving Workshop into two areas: one for "the development of fabrics for use for interior construction (models for industry)" and the other for "speculative exploration of material, form, color in tapestries and carpets" (ibid.). This dual approach led to the unique development of Bauhaus textiles, which further flourished after the school's move to Dessau in 1925. Bauhaus textiles evolved to suit modern interiors, both functionally and aesthetically, and were finally seen as equal partners in architecture interiors after the establishment of the architecture department in 1927. This change is also understandable from the viewpoint of architecture, as architects started to create buildings with large glass walls and white surfaces; textiles were more necessary than ever to regulate the light and view from outside. Furthermore, textiles were designed more in terms of structure. As the name Bauhaus, from the term bauen



Fig.62

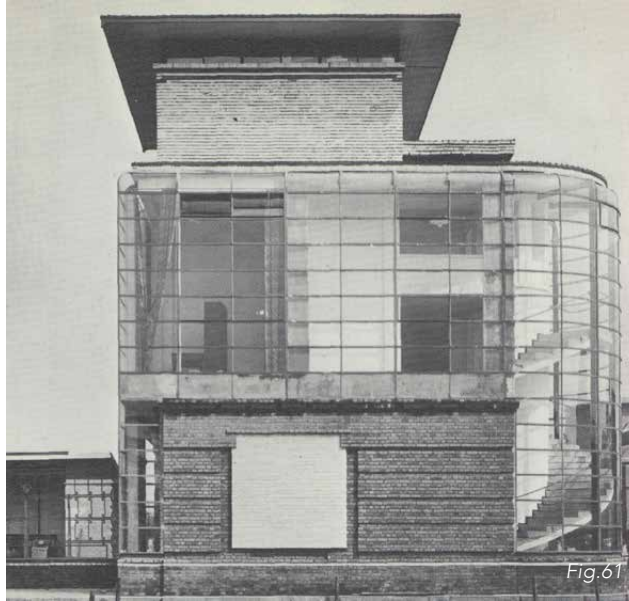


Fig.61

Left, Fig.61 Walter Gropius, Model Factory, Cologne, 1914, side elevation. / Far left, top to bottom, Fig.62 Gunta Stölzl, wall hanging, slit tapestry red/green, 1927/28. / Fig.63 Living room of Georg Muche's experimental Haus am Horn. Rug by Martha Erps. 1923. / Fig.64 Walter Gropius' office, part of the 1923 Bauhaus Exhibition. Wall hanging designed by Else Mögelin, rug designed by Gertrud Arndt.



Fig.63

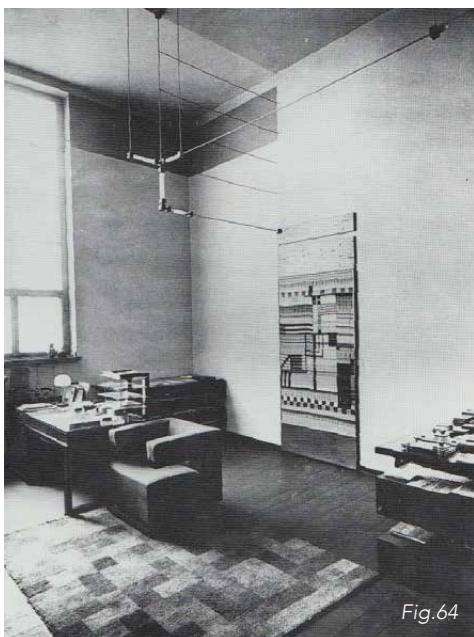


Fig.64

(to construct) implies, “[t]he conflation of *bauen* as construction and *bauen* as structure became the underlying philosophical concept of the Dessau Weaving Workshop” (Wortmann Weltge 1993, p.101).

An early example of the integration of textiles and interiors dates from 1923, when the Bauhaus’ first public exhibition was held. The Haus am Horn, an experimental house built to present the collaborative works of the Bauhaus, was designed by Georg Muche, master of the weaving workshop from 1921. In its living room, a rug by Martha Erps unifies the ensemble of furniture (fig. 63). Its pattern of squares and stripes are associated with the rigid shapes of the furniture, but also is designed so that the pattern is placed in an abstract composition, accompanied by curves so as to direct the viewer’s sight towards the adjacent room. Gropius’s office was also open to the public during the exhibition, and inside were also two textile works (fig. 64). Gertrud Arndt’s area rug echoes the geometric lighting, and “[a]n abstract silk hanging by Else Mögelin, mounted between wooden boards, is in harmony with both the interior architecture and the shape of the furniture” (ibid., p.63-64).

Anni Albers and the Bauhaus Weavers

Architectural textiles were perhaps most investigated by the weaver Anni Albers. She too was influenced by Klee, and was first producing magnificent wall hangings in multiple colors, adding vitality to interiors around the mid-1920s. However, when architect Hannes Meyer replaced Gropius as the school’s director in 1928, the Bauhaus’s orientation moved towards industrial production, and this significantly affected Albers’ textile designs. Her color palette changed from the bold colors towards more neutral colors, and she worked more with materials and structures, often in experimental ways. Architect and designer Buckminster Fuller affirmed that “Anni Albers, more than any other weaver, has succeeded in exciting mass realization of the complex structure of fabrics. She has brought the artist’s intuitive sculpturing faculties and the age long weaver’s arts into historical successful marriage” (qtd. in Weber 2004, p.25).

One of Albers’ greatest accomplishments at the Bauhaus was her diploma in 1930, for which she designed a sound-absorbent curtain

Left, top to bottom, Fig.65 Anni Albers, dividing curtain for Harvard Graduate Center, double bedroom, 1949. Linen and cotton. New York, Cooper-Hewitt, National Design Museum, Smithsonian Institution, Gift of Anni Albers. / Fig.66 Anni Albers, free-hanging room divider, c.1949. Cotton, cellophane, braided horsehair. New York, Museum of Modern Art, Gift of the designer. / Below, Fig.67 Anni Albers, free-hanging screen, c.1948. Walnut lath, dowels, and waxed-cotton harness-maker's thread. New York, The Metropolitan Museum of Art. / Fig.68 Anni Albers, sample for drapery material, c.1945. Cotton, rayon and metallic yarn. New York, Cooper-Hewitt, National Design Museum, Smithsonian Institution, Museum purchase in memory of Mrs. John Innes Kane. / Fig.69 Margarete Leischner, curtain material, 1927. Wool, cotton and chenille.

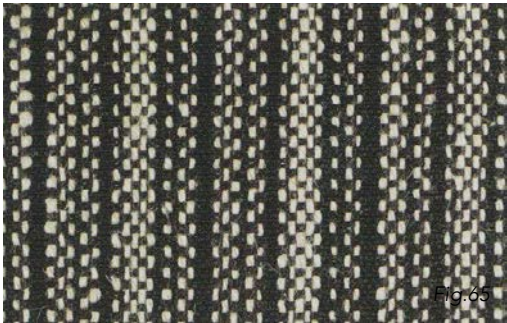


Fig.65

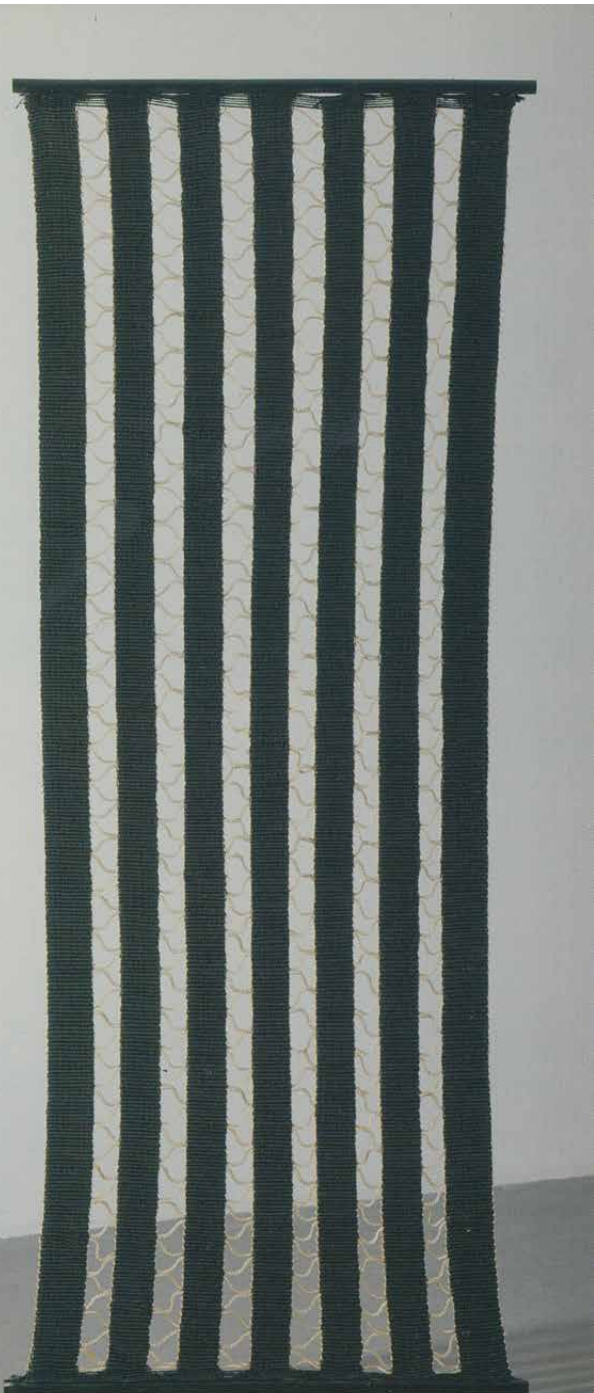


Fig.66



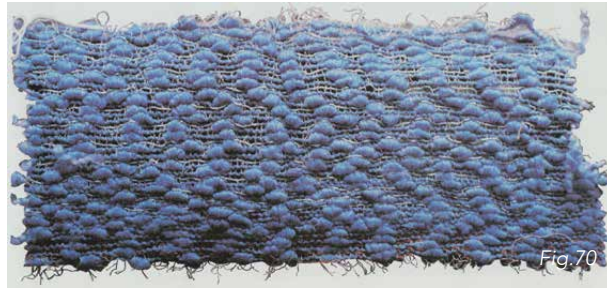
Fig.67



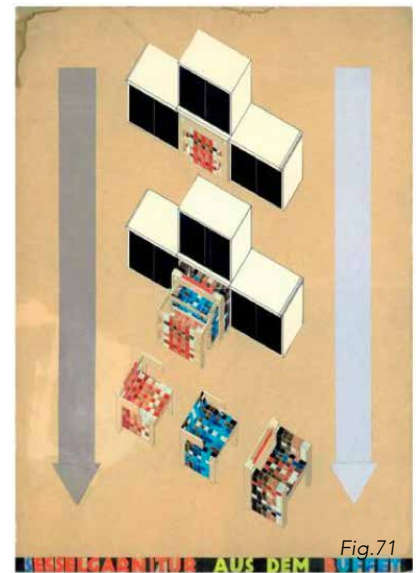
Fig.68



Fig.69



Left to right, Fig. 70 Margarete Leischner, curtain material. / Fig. 71 Sesseln garnitur aus dem Buffet, poster, Atelier Singer-Dicker, 1927.



for the auditorium of Hannes Meyer's Bundesschule des Allgemeinen Deutschen Gewerkschaftsbundes (the Educational Centre of the Trade Union) in Bernau. The curtain was woven on a cotton warp with a cellophane front, to reflect light, and with a chenille back, for better acoustic regulation. The Zeiss Ikon Goertz Company tested her fabric, scientifically proving its effectiveness. After moving to the United States with husband Josef in 1933, Anni designed curtains, bedspreads and room dividers for the dormitory rooms of the Harvard Graduate Center, designed by Walter Gropius and his firm. Here, she succeeded in creating textiles that could stand the rough treatment of the environment as well as provide sufficient privacy in the bedrooms. The heavy linen and cotton textile is one example, where the pattern is irregular so as to obscure stains and other damage (fig. 65).

Albers not only produced interior fabrics that focused on durability and acoustics. Many of her surviving works are semi-transparent, in which the innovative structures create open holes through which the other side is visible. For example, she designed a free-hanging room divider in the same year as the Harvard Graduate Center works. Albers used cotton, cellophane, and braided horsehair to weave this lyrical piece, where strong vertical lines are combined with curving yarns in between (fig. 66). Her remarkable weaving skills led to textile solutions that balanced form and function, enhancing atmospheres of architectural space (fig. 67, 68).

Albers was not the only successful weaver in the Bauhaus; other weavers were also experimenting with interesting materials to create functional fabrics. In 1927, Margaret Leischner produced a curtain fabric in wool, cotton and chenille (fig. 69). Not only is it sound absorbing, it is also reversible so that the fabric can be enjoyed to its maximum extent. She also designed curtains

with partial transparency, utilizing uneven wool yarns (fig. 70). Gunta Stölzl has also underlined that textiles for everyday use "are necessarily subject to accurate technical, and limited, but nevertheless variable, design requirement. The technical specifications: resistance to wear and tear, flexibility, permeability or impermeability to light, elasticity, light- and colour-fastness, etc., were dealt with systematically according to the end use of the material" (qtd. in Wortmann Weltge 1993, p.102). Since the Bauhaus Weaving Workshop was competent enough to produce textiles that meet these multiple requirements of new interiors, their products were favored among both individual customers and progressive architects.

Bauhaus students have also succeeded in the overlapping field of textiles and architecture after their studies, for example Friedl Dicker who attended the Weaving Workshop during its earlier days. She left the Bauhaus in 1923 and started the "Singer-Dicker Studio" with Franz Singer in Berlin, later moving to Vienna. There, the duo designed radical interiors, both domestic and public, also designing the suitable textiles and furniture (fig. 71).

Later in her years, Anni Albers produced various writings related to weaving and architecture. Like Gottfried Semper, she believed in their historical link (Wortmann Weltge 1993, p.168). In her essay "The Pliable Plane: textiles in Architecture" in 1957, she compares the processes of weaving and building, and finds similarities as well as differences. She refers to their different impacts as follows:

[Fabrics] can be lifted, folded, carried, stored away and exchanged easily; thus they bring a refreshing element of change into the now immobile house. The very fact of mobility makes them the carrier of extra aesthetic values. A red wall may become

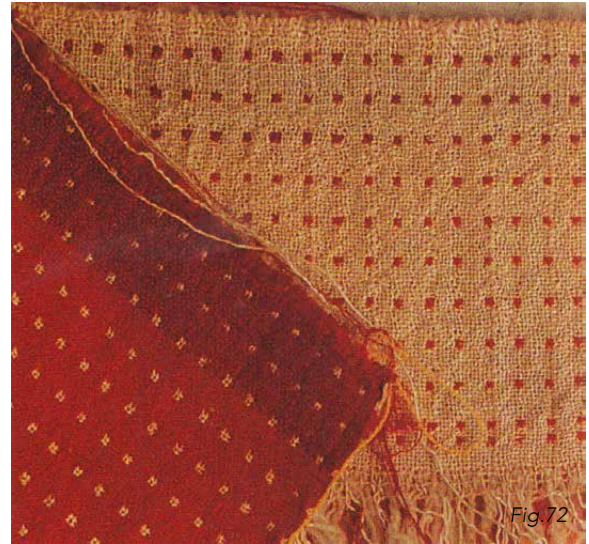


Fig. 72

threatening in the constancy of a high pitch, while red curtains of equal color intensity and able to cover an equal area can be of great vitality and yet not overpowering because the red area can be varied by drawing the curtain.

Here, Albers has referred to textiles as mobile objects that enhance the static spaces of architecture. Furthermore, Albers also affirms the changing of the roles of textiles in relation to architecture:

If we recall the attributes we have given [textiles] : insulating, pliable, transportable, relatively lightweight, all of these have been and still are active, as they were outdoors, in the interiors of houses all over the world throughout the centuries. But with their relaxed duties, that is, no longer having to guard our life, they have accumulated more and more functions that belong to another realm—aesthetic functions. These, in time, have moved so much to the foreground that today "decoration" has become for many the first and sometimes only reason for using fabrics. In "decoration" we have an additive that we may well look at, if not skeptically, at least questioningly.

Albers even foresees a further use of spatial textiles, referring to Japanese interiors:

Fabrics, however, could be incorporated into the interior planning far beyond an occasional partition. A museum, to give a large scale example, could set up textile panels instead of rigid ones, to provide for the many subdivisions and backgrounds it needs. Such fabric walls could have varying degrees of transparency or be opaque, even light-reflecting. They could be interchanged easily with changing needs and would bring an intensified note of airiness to a place. In ancient Japanese houses veil-like fabric panels were

used to form rooms and to allow the breeze to pass through. (The Japanese movie "Gate of Hell" shows such use in early times.)

Overall, Anni Albers can be identified as the most architectural weaver in modern times. She and other Bauhaus weavers were essential in developing contemporary textile design. The question now is to consider the next step after Albers' developments. Architecture is not as static as before, and textiles need further innovations to accommodate more fluid activities. This will be further discussed in Chapter 3.

After the Bauhaus

When Josef and Anni Albers started to teach at Black Mountain College in North Carolina, the ideas of the Bauhaus, which had closed the same year, spread and influenced many American students. Anni directed the Weaving Workshop there, and students produced both functional items to sell as well as commissioned work, for airplanes, public halls, dormitories and the stage (Wortmann Weltge 1993, p.164). Anni Albers herself continued to explore the relationship between textiles and architecture in America, and her writings gained the respect of architects and designers alike. In the prestigious magazine *Art and Architecture*, she affirmed "that textiles for interior use can be regarded as architectural elements" (qtd. in Wortmann Weltge 1993, p.169), and did not regard them as decorative additions to buildings.

Albers' teaching was succeeded by Trude Guermonprez, who also embodied the Bauhaus ideals through her training in Germany (fig. 72). Even after Albers' leave, her notions in structural textiles and their relation to architecture was passed down for generations to come. Kay Sekimachi, who studied under Guermonprez,

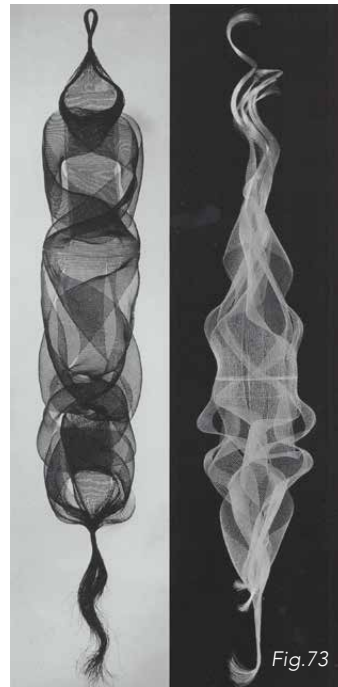
Opposite page, Fig.72 Trude Guermonprez embodied the versatility of the thoroughly trained weaver. This stitched double weave dates from the 1950s. / From left to right, Fig.73 With her tubular hangings in nylon monofilament, Kay Sekimachi pioneered the exploration of three+dimensional space. Her two versions of Amiyose in clear monofilament, quadruple and tubular weave were both produced in 1965. / Fig.74 Upholstery fabric woven by Else Regensteiner and Julia McVicker and marketed as fabric co+ordinates by their studio, Reg-Wick Handwoven Originals. Cotton, wool, novelty yarns and Lurex, 1948. / Fig.75 Angelo Testa worked closely with interior designers and architects. His casement fabrics fulfilled the need to cover vast expanses of glass windows in modern high-rise interiors.

utilizes contemporary materials like nylon monofilament in her double and triple weaves to explore three-dimensional space (fig. 73).

Furthermore, a New Bauhaus was established in Chicago in 1937, where Marli Ehrman became the head of the Weaving Workshop. She collaborated with Austrian-born interior designer Marianne Willisch on architectural commissions, for example in the Oak Park Public Library interior. She also designed the curtains for Mies van der Rohe's Lake Shore Drive Apartments, which is further discussed in page 57 to 58.

The New Bauhaus closed the next year, but reopened in 1939 as the School of Design, later credited as the Institute of Design in 1944. Students Else Regensteiner and Julia McVicker opened the 'reg-wick' custom studio in 1945, where they produced woven interior fabrics that suited the modern offices and residences built during the period (fig. 74). Meanwhile, Angelo Testa, the first graduate from the Institute of Design, worked mostly for industry but with a strong sense of architectural thinking. He collaborated with many interior designers and architects, as his fabrics were favorable to cover large window areas (fig. 75). Charlotte Moser noted in 1984 that "Testa has been concerned with maximizing a sense of space by using the most minimal geometric elements" (qtd. in Wortmann Weltge 1993, p.180) in his textiles.

The influence of Bauhaus textiles can be found in numerous works, and the above examples are only a few from the designers who were directly connected to the Bauhaus as a academic institute. Furthermore, the Bauhaus influence continues today in multiple disciplines. Its striving for functional designs and humanizing effects in architecture is not something of the past, and is still sought after by many designers of today.



2.6.2 The Maestros

The Bauhaus was progressive in their collaborating of multiple disciplines, but individual designers were also important in bringing forward new ideas to the modern society. In the realm of architecture, three architects are often referred to as the maestros; Frank Lloyd Wright, Le Corbusier and Mies van der Rohe all proposed revolutionary works, questioning the architectural ornamentation of the past. Interestingly, they each had various viewpoints towards textiles as well.

Frank Lloyd Wright

Architect Louis Sullivan of the Chicago School was an early thinker in modern architecture. Even before the establishment of the Bauhaus, Sullivan utilized industrial developments to create buildings that “meet the emotional as well as the physical needs of human beings” (Rowland 1973, p.42). Although the systematic way of design is currently part of an ordinary practice, it was not usual in Sullivan’s time. Furthermore, his pupil Frank Lloyd Wright developed his ideas further and realized far many more projects, having greater impact in the advancement of modern architecture.

The first attribute of Wright’s works in this thesis context is the influence of Oriental art and architecture. Japanese aesthetics became influential throughout Europe during the late nineteenth century and early twentieth century, and Wright himself collected Japanese screens and prints. The fluid and flexible interiors of Japanese houses and their use of decorative structural elements greatly affected Wright. Diffused light similar to that in Japanese architecture is visible in Wright’s architecture. Instead of Japanese textile screens, the skylights, wood panels and concrete blocks interact with natural and artificial light to create this effect (fig. 76). Furthermore, the natural

environment is an important context in both Japanese architecture and Wright’s works. Details about Japanese architectural space are further discussed in Chapter 2.9.

The second textile-related feature is Wright’s textile block system. Wright was able to transform various construction materials into aesthetic elements of architecture, and with concrete he created textured blocks in which various geometric designs were cast. Their abilities to become structural elements within architecture and simultaneously become the design of the building surface itself are perhaps why they are termed textile blocks. These blocks also dominated the interior spaces, adding texture and a warmer feel compared to plain concrete walls. They composed walls, windows, doorways, grilles, fireplaces, terraces and even pools (Lind 1992, p.134). They were ornamental but were not accessory elements in architecture.

One of the purest examples of the textile block system is seen in the house for Samuel and Harriet Freeman in Los Angeles of 1923 (fig. 77). The building is constructed with sixteen-inch-square block units, of which there are 52 different pattern versions. Although the blocks are the structure that supports the house, they are placed and designed so that a variety of flexible spaces emerge between them (fig. 78). Another example is John Storer’s house in Hollywood of 1923 (fig. 79). It is recorded that many difficulties prevailed during its construction, and costs inflated from the original assumption. Nevertheless, these textured concrete blocks led Wright to exploit the full capacity of concrete in his later projects, such as the Elizabeth Noble Apartments (fig. 80). The concrete block aesthetic was also translated into glass in his National Life Insurance Building project in Chicago of 1924 (fig. 81) (Frampton 1992, p.186). Interestingly, Wright’s team of technicians

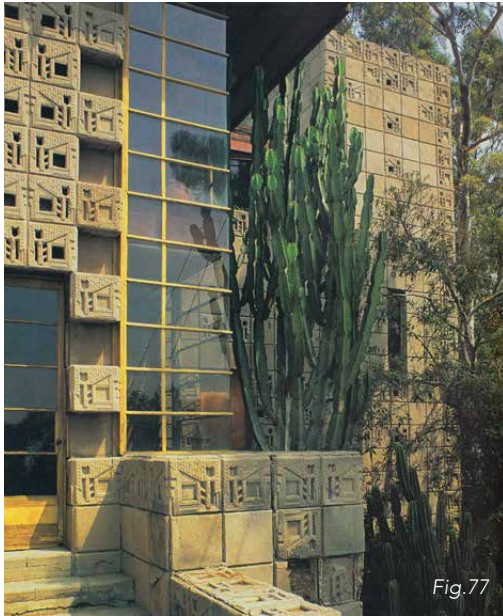


Fig.77



Fig.78

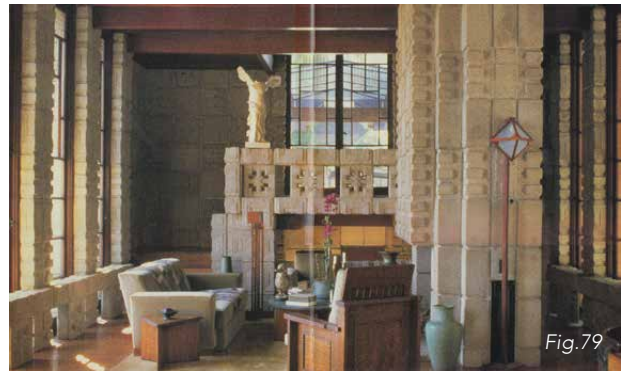


Fig.79



Fig.76

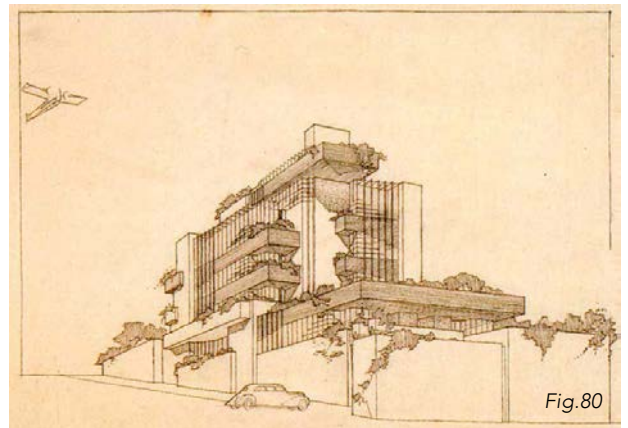


Fig.80

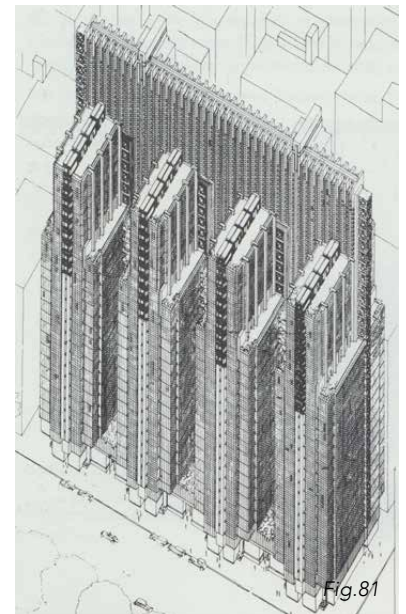
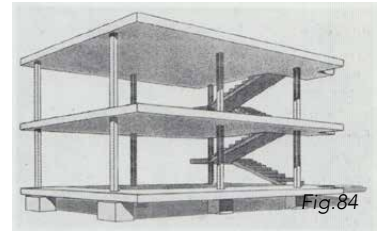
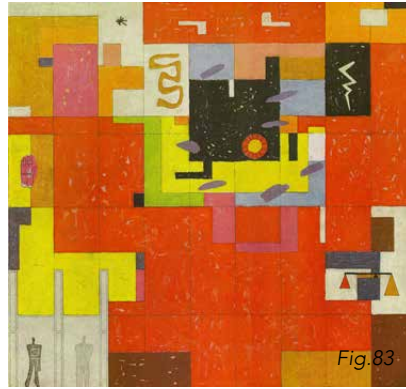
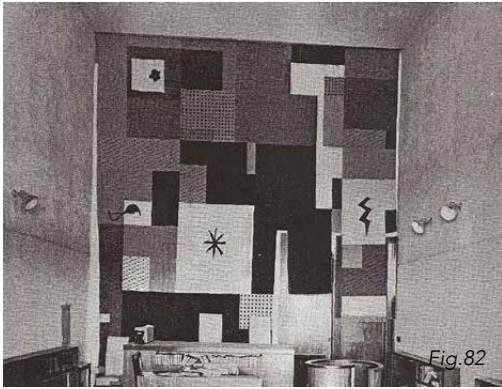


Fig.81

Clockwise, Fig.76 The drafting room in Taliesin West. Originally covered in canvas, it is now covered in plastic. / Fig.77 Exterior of the Freeman House in Los Angeles. Some of the fifty-two versions of the concrete block patterns are evident outside, massed and then balanced by the lightness of glass panels. / Fig.78 The power of the square motif inundates the house and is released only beyond its walls. / Fig.79 The living room of the Storer house in Hollywood. / Fig.80 Frank Lloyd Wright, Elizabeth Noble Apartments, Los Angeles. 1929/30. / Fig.81 Wright, project for the National Life Insurance Building, Chicago, 1924.



Left to right, Fig.82 Tapestries by Le Corbusier from a backdrop in the small courts of justice. / Fig.83 Tapestry detail. / Fig.84 Structure of Domino unit.

and craftsmen, also aiming to achieve a *Gesamtkunstwerk*, included Orlando Giannini, who not only designed textiles but also was a fabricator of glass.

Regarding actual fabrics, Wright himself was also known to assist in textile designs. He first used heavier fabrics such as velvets and tightly woven linens, but eventually used more natural, coarse fabrics, and his patterned fabrics were comprised of geometric elements. Similar to the textile blocks, fabrics also became one unit of the building, related to other objects and integrated into one scheme.

Le Corbusier

Like Wright, architect Le Corbusier also insisted on utilizing the nature of materials to achieve good design.

Charles Édouard Jeanneret – widely known as Le Corbusier – and Amédée Ozenfant were the originators of Purism, where they questioned the weakening force of Cubism and proposed a new purified form. In the magazine *L'Esprit Nouveau* of 1920, the Purists' writings were published in the name of Le Corbusier-Saugnier. The articles were reprinted in book form, titled *Vers une architecture* (*Towards a New Architecture*) in 1923, and then only Le Corbusier was credited. This became one of the most important manifestoes of the Modern Movement (Rowland 1973, p.153). In this book, Le Corbusier conveys his ideas clearly: "The house is a machine for living in" (qtd. in *ibid.*, p.154). He believed that the mass-production house, utilitarian and therefore healthy and beautiful, is appropriate for living. As Rowland quotes, the machine is not an inhuman object for Le Corbusier; it functions so as to affect the human senses (*ibid.*, p.155):

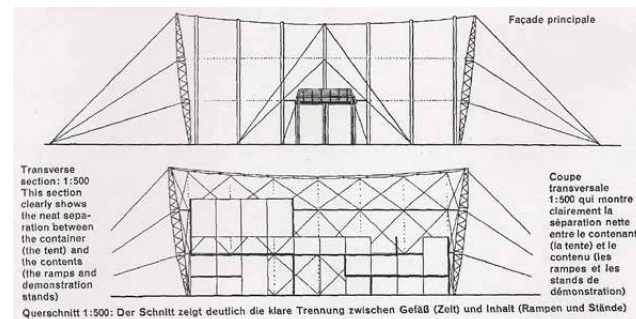
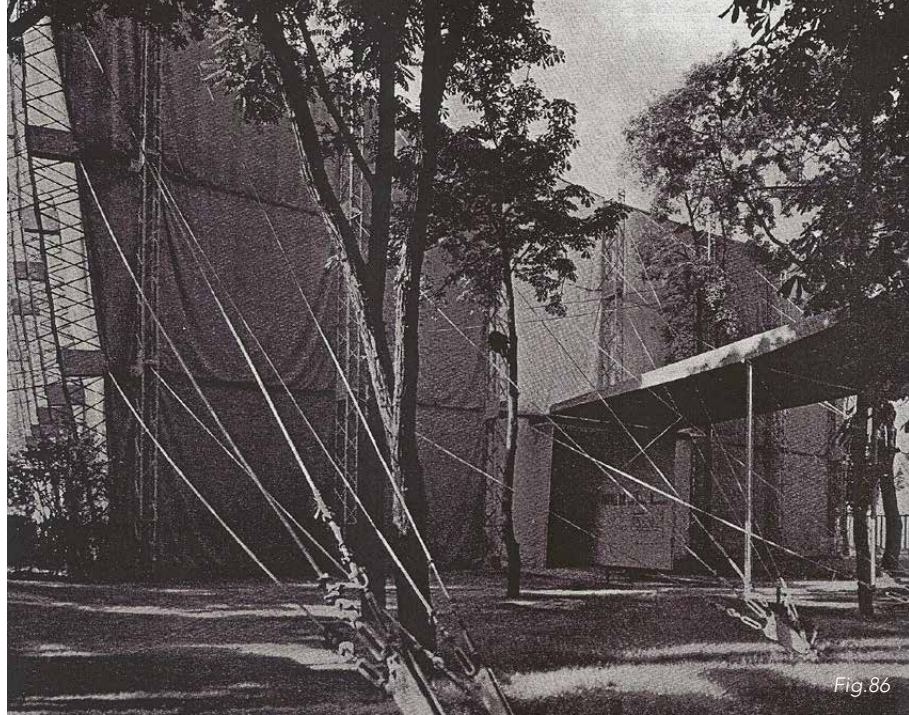
...[A]rchitecture which is a matter of plastic emotion...should use those elements which are

capable of affecting our senses, and of rewarding the desire of our eyes, and should dispose them in such a way that the sight of them affects us immediately by their delicacy or their brutality, their riot or their serenity, their indifference or their interest; these elements are plastic elements, forms which our eyes see clearly and which our mind can measure. These forms (sphere, cube, cylinder, horizontal, vertical, oblique etc.) work physiologically upon our senses and excite them.

In his model house *L'Esprit Nouveau* at the 1925 Paris Exposition, Le Corbusier placed a hand-woven Moroccan carpet. He favored its "literal warmth, bright colours, geometric patterns and nubby surface texture," but at the same time it was a common, functional object (Troy 2006, p.165). Le Corbusier's values in textiles balanced its artistic traits and its standardized use. He also related the scale of the pattern of the fabric to the scale of the room, and its ability to act as "a measuring rod" against various materials, surfaces and objects in interiors (qtd. in *ibid.*, p.168).

Le Corbusier also designed cartoons for tapestries, referring to them as "nomadic murals." They were mural works that could be rolled up and transported to a new place, he stated, just like the original use of tapestries in the Middle Ages. Besides tapestries, he also considered drawings, paintings and sculptures to be functional elements within modern architecture, and not as additional decoration (Davanzo Poli 2007, p.23). Anni Albers has referred to Le Corbusier's use of textiles as follows, in her essay "The Pliable Plane: textiles in Architecture" in 1957:

Le Corbusier, in a different way, incorporates textiles into an architectural scheme, using them as enormous flat wall-panels, banners, that carry color and form and serve perhaps also as sound-absorbing flats. Above all they become a focal point, as in the halls of his Indian High Court of Justice at Chandigarh (fig. 82,



83).

A prominent contribution to modern interiors by Le Corbusier was the Domino House, proposed as early as 1915 (fig. 84). It is constructed with simple slabs and columns in reinforced concrete, carrying the entire load, allowing the walls to be placed freely. This basic skeleton enabled architects to design new spaces, flows and views, therefore textiles also transformed according to the architectural space. In Le Corbusier's Villa Savoye and other projects of the time, the free plan also emancipated the façade, allowing the generous use of large glass panes (fig. 85). When curved, they induce the fluid movement representative of modernism. However, as Chris Dercon points out, curtains do exist among Le Corbusier's glass surfaces, which seems contradictory to the purist notion of transparency (2005, p.46). Dercon continues that "[o]n the contrary, [the curtains] add a 'primary image' to the building, an additional, diffuse transparency" (ibid.). Perhaps Le Corbusier placed curtains for the sake of its function, but also intended to place an additional layer to strengthen the sense of pure clearness when the curtains are drawn.

Le Corbusier did not strictly continue with the dogmatic ways of Purism, and from around the thirties onwards, he embraced both the vernacular and Classical monumentality in his later projects. He began to use natural materials in contrasting ways, and bold, structural forms were executed as well. For the Pavillon des Temps Nouveaux of the Paris Exhibition in 1937, Le Corbusier suspended canvas fabric of 1,200 square meters with a wire-cable to create a luminous exhibition space (fig. 86, 87). This textile architecture actually inspired the structure of the pilgrimage chapel at Ronchamp, completed in 1955 (fig. 88). Its dominant concrete roof with dynamic curves resembles the contours of massive fabric.

Overall, although Le Corbusier is seldom regarded as an architect with relations to soft material, his ideas and projects hint at the presence of textiles, both physically and metaphorically.

Fig.85 Le Corbusier, Villa Savoye, 1929-31. / Fig.86 Entrance facade of Le Pavillon des Temps Nouveaux. Blue canvas, white in the center, and red canvas over the entrance platform. / Fig.87 Section of pavilion. / Fig.88 Le Corbusier, the pilgrimage chapel at Ronchamp, 1953-55.



Fig.89

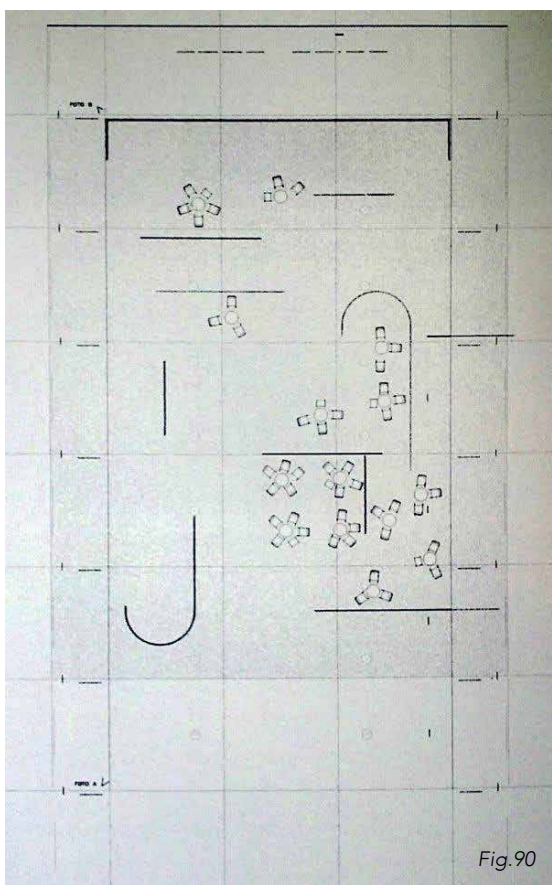


Fig.90



Fig.91

Top, Fig.89 Mies van der Rohe and Lilly Reich, Café Samt und Seide, 1927.
/ Fig.90 Plan of Café Samt und Seide. / Fig.91 Ludwig Mies van der Rohe.
Tugendhat House, 1930, Brno. Curved ebony wall in the open-plan living
area, chrome girders.

Left to right, Fig.92 Mies van der Rohe, German Pavilion, Barcelona. / Fig.93 Mies van der Rohe, women's sitting room, Mies House, Berlin Building Exhibition, 1931.



Mies van der Rohe

The German-American architect Ludwig Mies van der Rohe also made use of the free plan and developed it to its extreme. He noticed the modern needs of flexible spaces, and enabled spaces to be freely assembled within the skeleton construction.

This notion was combined with the ideas of partner Lilly Reich, leading to innovative interior solutions with use of textiles. Their collaboration in the Café Samt und Seide (Velvet and Silk Café) for the trade fair Die Mode der Dame (Ladies' Fashion) is, perhaps, one milestone in the overlapping field of textiles and architecture (fig. 89). The project was initiated with Krefeld silk manufacturer and art collector Hermann Lange, and took place in Berlin in 1927. Reich and Mies created a spatial structure of 850 square meters using velvet and silk fabric to create fluid spaces of different heights. The fabrics were suspended from tubular steel rods, ranging from two to six meters in height, placed curved or straight according to the intended space (fig. 90). The velvets were black, orange and red, and the silks were gold, silver, black and lemon-yellow (Frampton 1992, p.163). These were carefully combined to achieve multiple views of varying surfaces and colors, as well as to define architectural spaces. Another architectural use of textile is seen in the Tugendhat House of 1930, in Brno (fig. 91). Black velvet curtains and black and silver-grey silk could be drawn at night so that the inhabitants could feel safe from onlookers outside. Curtains also acted as partitions in the interior space, fulfilling the necessary privacy, but at the same time maintaining the sense of wholeness.

Lilly Reich was experienced in multiple fields such as exhibition design, clothing and furniture design, and in architecture. She acquired much knowledge about textiles, especially of the industry, while working at the Deutscher Werkbund, and she even became its first female board

member. Reich came to understand the many properties of textiles rather than their actual structures and techniques. Therefore, she was able to use textiles in an architectural way; not as mere additions, but manipulating its space. Her intimate collaborations with Mies added much more to his interiors, and the extent of her share in the work is often ambiguous. Reich is known to have advised the colors and materials in Mies' work, which is apparent in a letter from Reich to Mies in 1940, stating that she was thinking about "writing down some things about color, material, the theories about them, their relationship to each other, a plan" (qtd. in Lange 2006, p.99).

In other projects, however, Reich and Mies have commissioned textiles from independent designers. The weaver Alen Müller-Hellwig (1901-1993) produced wall and floor coverings for the German Pavilion in Barcelona in 1929, Tugendhat house in 1930, and the *Dwelling in Our Time* exhibition in Berlin in 1931 (Troy 2006, p.126) (fig. 92, 93). Müller-Hellwig was specialized in weaving with natural sheep wool, and her rugs were especially admired by Reich and Mies. Her textural works accompanied the other materials in Mies' architecture, such as chrome, leather, glass and stone, which all had no superficial decoration, and were precisely unified as a *Gesamtkunstwerk* (ibid.). Müller-Hellwig was not from the Bauhaus, but was active during the same time, and was even more successful than most of the Bauhaus weavers. She also received commissions from architect Hugo Häring (Wortmann Weltge 1993, p.100).

Focusing back on Mies' architecture, like Le Corbusier, he also exploited the transparency of glass. Mies was able to manipulate glass "which he used in such a way to allow it to change under light from the appearance of a reflective surface to the disappearance of the surface into pure transparency: on the one hand, the apparition of nothing, on the other, an evident need for support" (Frampton 1992, p.232). In Mies' Lake Shore



Fig. 94



Fig. 95



Fig. 96

Drive Apartments in Chicago, built between 1948 and 1951, Frampton explains that the glass windows are rendered “after Semper’s prescription – as a woven fabric” (fig. 94) (ibid., p.234). Different sized windows create a rich rhythm with the structural frame, and are integrated into a large surface, much like a textile fabric. Furthermore, the curtains designed by the Bauhaus weaver Marli Ehrman alter the reflectiveness of glass, adding another texture layer of vertically sliding blinds and horizontally adjustable curtains (Krüger 2009, p.28). The same “woven” facades are visible in the 39-story Seagram Building in New York, completed in 1958 (fig. 95).

The Farnsworth House designed in 1946 is one of Mies’ best known works, built in Plano, Illinois (fig. 96). Here, an interior space floats 1.5 meters above the ground, sandwiched between two slabs. The space is enclosed by a glass skin, creating a sense of nothingness. Curtains of natural off-white shantung silk exist, but when they are drawn open the building’s transparency is emphasized to a greater extent (Frampton 1992, p.235). However, it can be affirmed that Mies chose lighter and more delicate material here than the textiles in his previous works, perhaps integrating them into his architecture in a new, more conceptual way, compared to his previous collaborations with Reich.

Overall, the above three architects and their collaborators manifested various Modernist examples, and simultaneously brought contemporary textiles near the spotlight of architectural interiors. What is now ordinary did not exist before the times of these architects – and their radical ideas still possess the extensive force to surprise us once more.

Left to right, Fig. 94 Ludwig Mies van der Rohe. Lake Shore Drive Apartments, exterior, street level. 1948-1951. Chicago, Illinois. / Fig. 95 Mies van der Rohe and Johnson, Seagram Building, New York, 1958. / Fig. 96 Mies van der Rohe, Farnsworth House, Illinois, 1945-1951. / Opposite page, top to bottom, Fig. 97 Richard Neutra, Lovell Health House, Griffith Park, Los Angeles, 1927. / Fig. 98 Rudolf Schindler, Lovell Beach House, California, 1926. / Fig. 99 Maria Kipp. Hand loomed gauze textile, 1939. Cotton, rayon, mohair and metallic thread. Collection of Cranbrook Art Museum, Bloomfield Hills, Michigan. / Fig. 100 Rietveld. Plans of the upper floor, ‘closed’ (above) and ‘open’ of the Schröder House, Utrecht, 1924.

2.6.3 Other Modern Textiles and Architecture

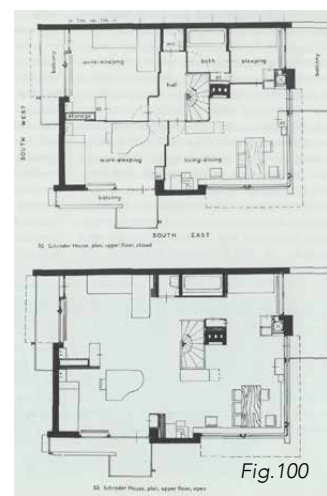
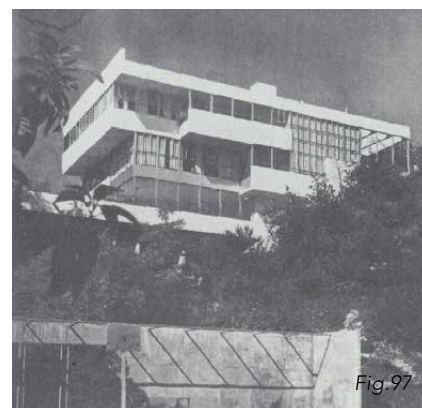
The progressive ideas of the above architects were not the sole accomplishments of the Modern Movement. Flexible spaces and integrated interiors were investigated by designers and architects alike, and several styles and non-styles coexisted in the first half of the twentieth century.

The International Style

Modernism, Functionalism, and the International Style – actually, all of these terms point to the similar style in architecture, where buildings were rectilinear and modern materials were utilized, often fabricated for faster construction. The term “International Style” came into use already in 1932, when an exhibition with the same name was organized as the first architectural exhibition in the Museum of Modern Art in New York (“International Style (Architecture)”). As the above examples already showed, large windows were prominent elements during this time. Therefore, curtains were now seen from both inside and outside of architecture, contributing greatly to the overall look of a building. In the pictures of architect Richard Neutra’s works, who is said to have culminated the International Style, and also of Rudolf Schindler’s projects, curtains are significantly present (fig. 97, 98). In fact, the same weaver, Maria Kipp, received commissions from both architects. Kipp (1900-1988), who was familiar with the spatial textiles by Mies and Reich, created pieces with three-dimensional depth with the combination of various textures (Troy 2006, p.137) (fig. 99).

The flexibility of interiors was also a prominent feature of the era, and is demonstrated in Gerrit Rietveld’s architecture. In his Schröder House of 1924, moving walls were installed so as to divide the second floor into smaller sections (fig. 100). They could even be stored out of sight when a single, large room was necessary. The Schröder House became an example for future works, demonstrating its maximum spatial flexibility.

In Japan, the International Style was introduced by Antonin Raymond through his work in 1923. The Czech-American architect worked under Frank Lloyd Wright, and went to Tokyo to supervise Wright’s Imperial Hotel (Frampton 1992, p.257). In his own house built in 1923, he succeeded in imitating the traditional Japanese wooden construction with



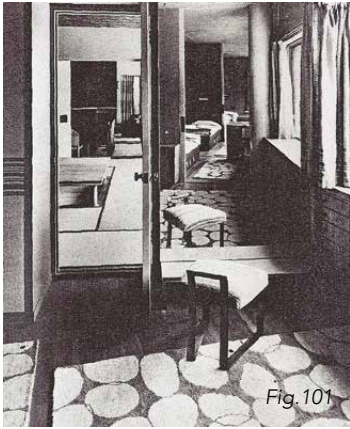


Fig. 101

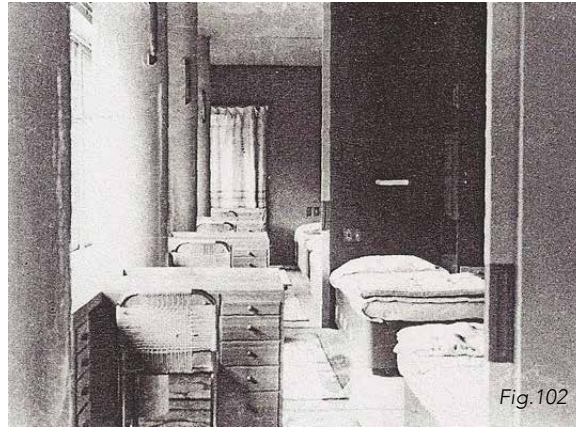


Fig. 102

Left to right, Fig. 101 View from dressing room towards dining room, Tetsuma Akaboshi house, 1931. Antonin Raymond. / Fig. 102 Partitions open between children's rooms, Tetsuma Akaboshi house, 1931. Antonin Raymond.

concrete. Raymond also used Japanese shoji screens and tatami on the floor in his Akaboshi and Fukui houses in the mid 1930s, integrating European and Japanese aesthetics (fig. 101-103).

Japan itself developed its own Modernism Movements, and one project is certainly worth mentioning in this thesis context. Architect Kenzo Tange designed the twin Olympic stadiums for the Tokyo games in 1964 (fig. 104). They were covered by catenary steel roofs, which hung from curved concrete ring beams (Frampton 1992, pp.259-260). The dynamic structure creates a novel atmosphere inside, and it has been admired by architects worldwide. For example, Frei Otto was inspired by the Olympic stadium for his own arena designs for the games in Munich, in 1972. Details of Otto's work and other tensile structures will be discussed in Chapter 2.8.

The Textile Industry and Home Furnishings

Modernism did not spread to all industries in an instant. During the beginning of the twentieth century, multiple styles existed in textiles and some were simply successors of the past. It was surely a time of increasing consumerism, and the constant demands of textiles influenced the textile industry.

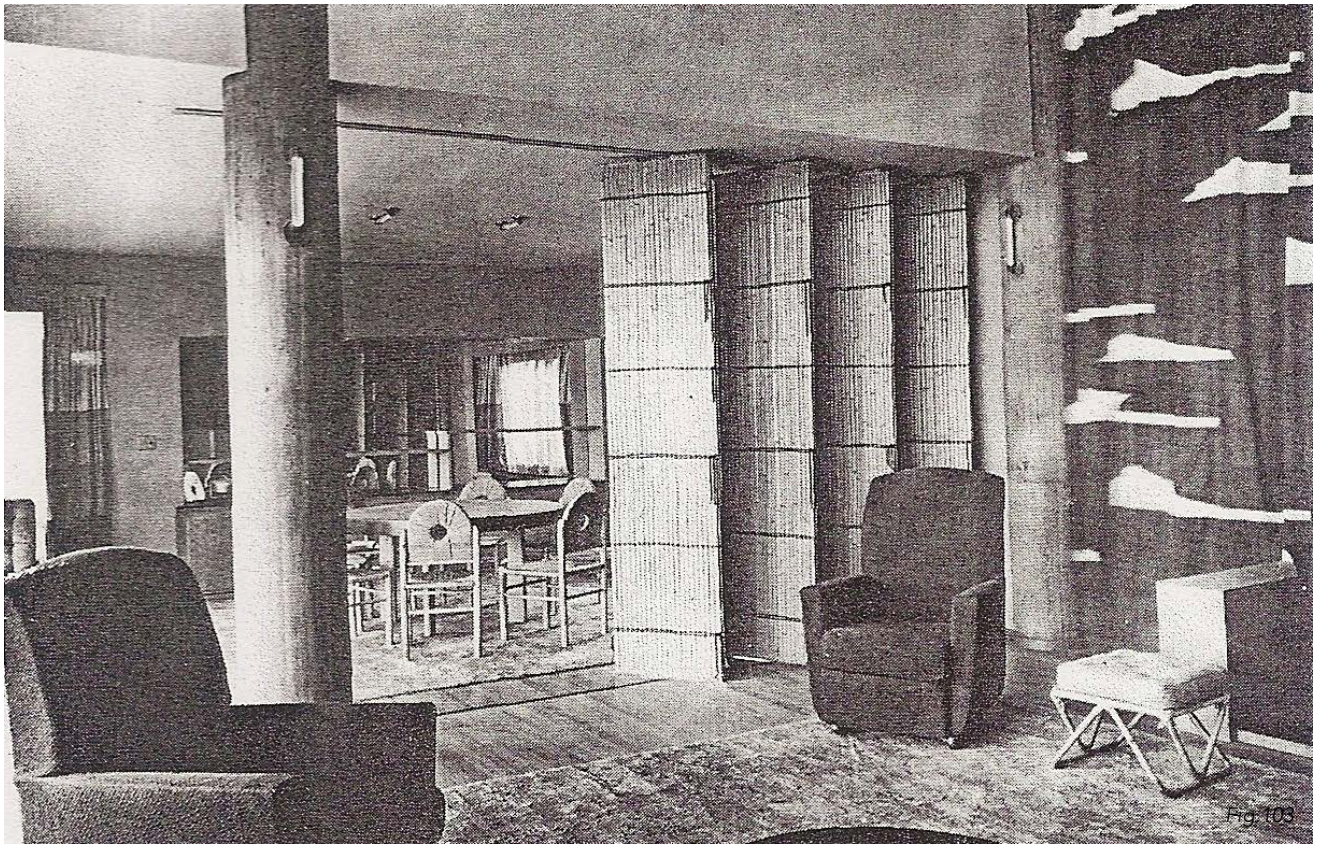
One particular style of the 1920s was Art Deco, which was the decorative style that surfaced at the 1925 International Exposition of Modern Decorative and Industrial Arts in Paris. Art Deco consisted of bold, geometric shapes in bright colors, with a light background, and the overall look was outrageous but stylish during the inter-war period. One of the first designers in the Art Deco style was the French designer André Groult. He and other designers in France were against the Art Nouveau

style around the first decade of the century, and "favoured traditional techniques enlivened with fantasy" (Gibbs 1994, p.159) (fig. 105). The Art Deco style proposed new ornamentation elements, but interior decorations in general became simpler, also due to the war. French-style drapery was still fashionable among conservative households, but windows certainly had fewer treatments, and the luxurious curtains of the nineteenth century faded by the 1920s. Blinds became more common, including ones made of silk and linen. Exterior blinds were also frequently applied.

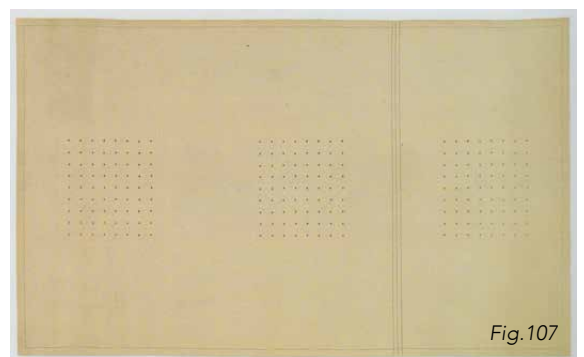
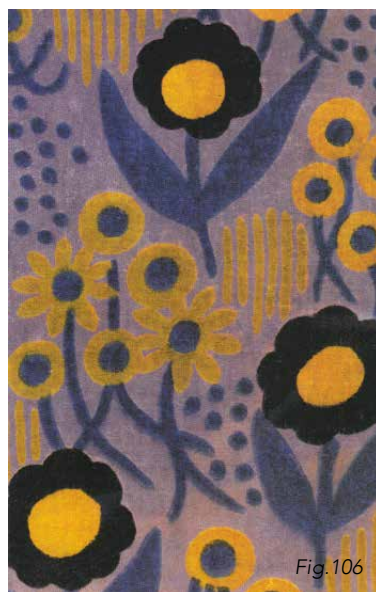
The Avant-garde fine art movements influenced two workshops during the first decade of the twentieth century. The first one is the Omega Workshop in London, which was a "cooperative atelier/maison, or studio/boutique where artists could design, manufacture and sell utilitarian items created" (Troy 2006, p.68). They produced many curtains, rugs, scarves and wall hangings. The second is the Atelier Martine in Paris, founded by Paul Poiret. He was originally a fashion designer, and admired the Wiener Werkstätte's production. At the Atelier Martine, Poiret experimented with unique fabric designs created by children, producing brightly colored works (fig. 106). The Atelier also produced fourteen wall hangings designed by Raoul Dufy for the 1925 Paris Exposition.

Modernist Textiles

On the other hand, Eileen Gray was an early designer of furniture and interiors with modernist influence. The Irish born designer settled in Paris, and was affected by the geometric styles of De Stijl and Cubism, and also followed Le Corbusier's ideas of proportioned designs (Troy 2006, p.128). Gray was keen on the inherent properties of certain materials, and aimed to create new textures and surfaces that would complement austere Modernist interiors (fig.



Above, Fig. 103 View from living room towards dining room, Kikusaburo Fukui villa, Atami, Japan, 1935. Antonin Raymond. / Left, Fig. 104 Kenzo Tange, Yoyogi National Gymnasium, Tokyo, 1963-64. / Below, left to right, Fig. 105 André Groult, sample of model no. 7139, silk lampas with light blue and pink flowers, 1913, produced by Lamy & Gautier of Paris, detail. Prella Archive, Paris. / Fig. 106 *The Crocus*, printed velvet, 1912, produced by the Atelier Martine for Paul Poirer, detail. M. N. Sudre and M. P. Benetti Collection, Paris. / Fig. 107 Eileen Gray, felt mat, designed c. 1928. Wool felt.



107). Although Gray herself did not weave her pieces like the Bauhaus weavers, she and other designers and “ensemblers” such as Maurice Dufresne, Emile-Jacques Rühlmann, Marion Dorn and Betty Joel were more conscious of the context of textiles in actual use, therefore producing integrated interiors with more emphasis on function and quality than on decoration and wealth. For example, Marion Dorn (1896-1964) also abandoned clear references to subjects and focused on the structure of fabrics. She created sculptured textiles by use of weaving and piling during the mid thirties (fig. 108). Paul Rodier and Hélène Henry also utilized their knowledge of weaving construction to create textured interior fabrics, which were visually enhanced by the direction of the yarns and the angle of light, and not by pictorial decoration (Troy 2006, p.128).

Sonia Delaunay (1885-1979) was one of the first textile designers to completely abandon illustrative motifs and experimented with abstract forms. She focused on the pure relationships of colors and textures, and her adaptable textiles could function as interior or fashion fabrics. Furthermore, she aimed to achieve “simultaneity,” where the colors and patterns created dialogues with other objects, and were activated by the movement of the textile as well as the illusion of it moving (Troy 2006, p.94). This “simultaneity” is captured in a photograph of a model with Delaunay’s textiles (fig. 109). Delaunay had this spatial sense of textiles as early as 1913, when she started to create “simultaneous” clothing (ibid., p.95). She also had experience in site-specific textiles, such as the organdie

curtains for Guillaume Apollinaire’s house in 1912.

In Italy, its original avant-garde movement of Futurism influenced its textiles. The Futurist Movement was led by Filippo Tommaso Marinetti, who published its first manifesto in 1909. Futurism abandoned the conservative styles of the past, and focused on modernity and speed. Giacomo Balla proposed unique clothing that reflected the new style, and also designed furnishing textiles (fig. 110). Between 1920 and 1942, another Futurist Fortunato Depero produced decorative panels, cushions and other furnishing textiles with his wife Rosetta (Davanzo Poli 2007, p.27) (fig. 111). For the Monza exhibition in 1923, Depero was appointed to represent the Futurist movement with his interiors. He created a “total work of art,” where separate objects such as sculptures, tapestries and painting were unified to create a lively atmosphere (ibid.).

Overall, textiles gradually evolved with the development of modernism, and their designs reflected the environment that they would be placed in. The modernist textile is significantly acknowledged in the Golden Gate Exposition in San Francisco in 1939; over 200 textiles were exhibited, ranging from Anni Albers, Raoul Dufy to Loja Saarinen (Troy 2006, p.168). The exhibition supervisor and weaver Dorothy Liebes explained that the modernist textile is “both a ‘dependent expression’ in terms of its relationship to architecture and a ‘bona fide textile expression’ in terms of its role as an inherently unique art medium with a distinct set of aesthetic conditions” (ibid.). By this time, textiles possessed multiple roles, satisfying both functional and aesthetic needs of the architecture of the day.

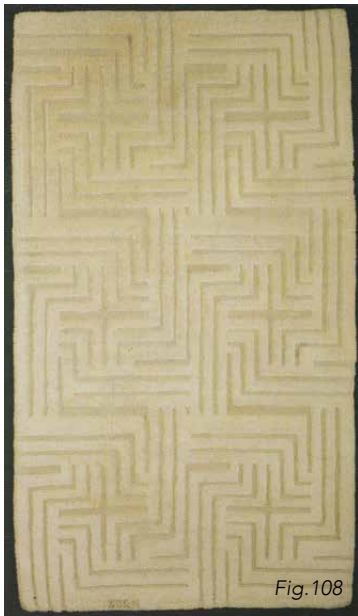


Fig.108



Fig.109



Fig.110



Fig.111

Top left to right, Fig.108 Marion Dorn, rug, Wilton Royal Carpet Factory Ltd (manufacturer) c.1934. Hand-knotted wool. / Fig.109 Photograph of model draped in fabrics by Sonia Delaunay c.1925. / Left to right, Fig.110 Giacomo Balla, Sketch of Man's Evening Suit, 1914. Tempera on paper. Private collection, Rome. / Fig.111 Fortunato Depero, *Venetian Rhythms*, 1923, produced in the "Casa d'arte futurista" in Rovereto. Private collection, Rovereto.

2.7 Finland and Scandinavia: National Romanticism to Modernism

National Romanticism

Finland, like many other European countries, was influenced by the reform movements that occurred around the 1890s. The Arts and Crafts and Art Nouveau styles spread to Scandinavia as well. However, specifically in Finland, these international movements were combined with the so-called “Karelianism,” which was initiated from the strong interests in the Finnish folk epic *Kalevala*, which was collected and published by Elias Lönnroth in 1835. This nationalism became prominent between the early 1890s and early 1900s, and is referred to as “the golden age” of Finland. The arts flourished, the economy grew, and like other movements of the time, the unification of arts, architecture and handicraft was executed by artists and designers of various disciplines. Textiles were not an exception either. The leading figures of National Romanticism were the composer Jean Sibelius, painter Akseli Gallén-Kallela (1865-1931), and the architects Eliel Saarinen (1873-1950), Herman Gesellius, Armas Lindgren, and Lars Sonck (Frampton 1992, p.193).

A turning point in the realm of Finnish architecture and design during this time was the Paris World Fair of 1900. The architects Saarinen, Gesellius and Lindgren designed the Finnish Pavilion in the National Romanticism style, adorned with medieval Finnish motifs of plants and animals (fig. 112). The building also integrated the architecture trends of the time (Korvenmaa 2009, p.34). The leading Finnish artists presented their works and also participated in the designing of the exhibition. Therefore, individual crafts were integrated with the entire atmosphere of the building, raising the status of applied arts with the support of architecture. One of the important works exhibited was the ryijy, or piled weave rug, that went over multiple surfaces, simultaneously becoming a wall hanging, bench cover and rug (fig. 113). This unifying ryijy designed by Gallén was later named “*Liekki*,” meaning “flame,” and was reproduced several times by the Friends of Finnish Handicraft (fig. 114, fig. 116).

The architect trio designed other works of integrated interiors, and was also involved in the designs of curtains, tablecloths and upholstery. In the apartment on Fabianinkatu 17 of 1901, the interiors were actually the starting point of the design, which led to unique shapes in the windows and various recesses and protrusions (Amberg 1984, p.7) (fig. 115).

Gesellius, Lindgren and Saarinen designed two noteworthy works of total art. The first is the Hvitträsk at Kirkkonummi, west of Helsinki,



Fig.112



Fig.113

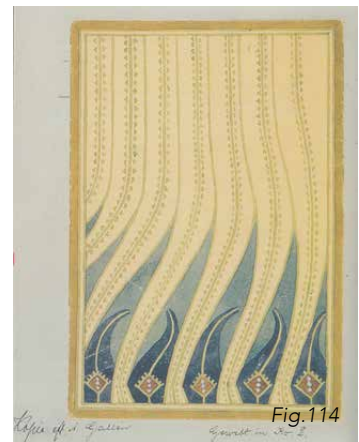


Fig.114

Top to bottom, Fig.112 The main vaulted interior space of the pavilion contained paintings by Axel Gallén of subjects from the *Kalevala*. / Fig.113 The Iris Room, with furniture and textiles designed by Axel Gallén, ceramics by A. W. Finch. / Fig.114 Sketch by Axel Gallén for the ryijy-rug for covering a bench that was made for the Finnish pavilion at the Paris World's Fair of 1900. Known as *Liekki* (flame), this design was later made in several versions by the Friends of Finnish Handicraft.



Fig.115



Fig.116

Fig.115 Gesellius, Lindgren and Saarinen, Fabianinkatu 17, dining room of Dr. Zilliacus's apartment, completed 1901. / Fig.116 'Liekki' ryijy in Hvitträsk. / Fig.117 Ryijy rug in Hvitträsk's dining room. / Fig.118 Suur-Merijoki's library, 1903, water-color.

built from 1902 to 1903. Hvitträsk was also the home and office for the three architects, and numerous objects were designed specifically for the interior. Similar to the ryijy described above, in 1914 Saarinen designed a rug for the dining room, which also acted as a sofa cover (fig. 117). The second project worth mentioning is the Suur-Merijoki Manor of 1903 near Viipuri, which is now part of Russia. Here, the designing of the details went even further than Hvitträsk. Whereas Hvitträsk is the architect's own home and the designs tend to be derived from personal choice, Suur-Merijoki was commissioned by industrialist Maximillian Neuscheller, and was designed at a new level. For example, textiles and furniture became one in the hall, with the furniture placed in relation to the pattern of the fabrics (fig. 118). Saarinen again collaborated with the Friends of Finnish Handcraft and designed a whole range of textiles, from ryijy rugs, tapestries, curtains, tablecloths, to furniture covers (Amberg 1984, p.21). From the textile works for a boudoir for the Friends of Finnish Handicraft's 25th anniversary exhibition in 1904, an obvious relation is visible to the works of C. R. Mackintosh. Later on, a growing social awareness of hygiene led to the disliking of anything that collects dust, including textiles, and Saarinen also reduced the amount of textiles and colors in his interiors, and focused more on the natural aesthetics of wood.

Eliel's wife Loja Saarinen (1879-1968) also contributed to many of the textiles in Saarinen's



Fig.117



Fig.118



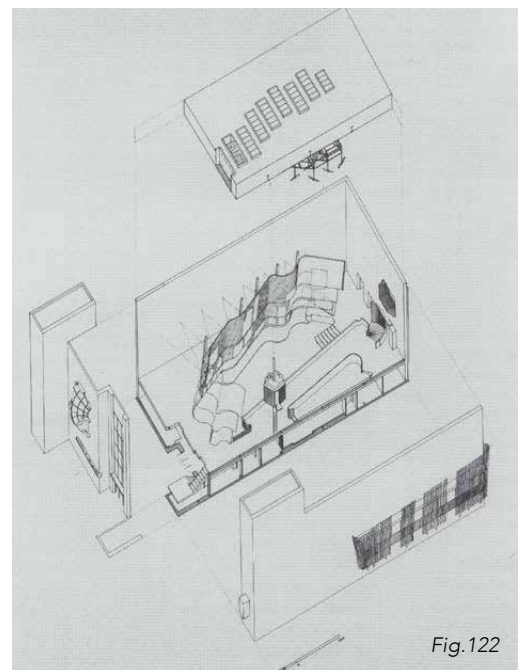
Left to right, Fig.119 Eliel Saarinen, *Roses*, 1903, woven in cotton and wool. Private collection. / Fig.120 Eliel Saarinen and Loja Saarinen. Photograph of Saarinen living-room, Saarinen House, Cranbrook. 1928-1930. / Below, Fig.121 The Finnish Pavilion for the 1937 World's Fair in Paris. / Fig.122 Axonometric perspective by Laura Mark of the Finnish pavilion at the New York World's Fair.

architecture. She was both a sculptor and a weaver. It is not sure to what extent Loja was involved in Eliel's works, but she may have had a hand in the design and execution of the 1904 ryijy *Ruusu*, meaning Rose (fig. 119). After the Saarinens' emigration to the US, Loja opened a weaving workshop at Cranbrook, Michigan in 1928, to produce textiles for the Cranbrook Academy of Art. Textiles for the Saarinen living room were also produced at Studio Loja Saarinen, and their role of integrating the interior space with patterns, textures and scale is clearly demonstrated (fig. 120) (Troy 2006, p.133). The studio also produced commissioned work by Frank Lloyd Wright.

Modernism and Alvar Aalto

Alvar Aalto did not follow the National Romanticism movement. His early works before the late 1920s drew upon Classicism, and around the turn of the 1930s, with other Nordic architects, he approached modernism. Aalto also was ambitious to produce a *Gesamtkunstwerk*, designing specific furnishings for certain architecture.

When speaking of Aalto's architecture in relationship to textiles and crafts, his two Finnish Pavilions demonstrate his approach towards interior objects and the accompanying spatial developments. For the 1937 Paris World Fair, Aalto designed a timber structure displaying the specific characteristics of wood material (fig. 121). The pavilion building itself was positively received, also by Le Corbusier, but the collaboration with Arttu Brummer, who arranged the exhibition interior, was a failure. The display was not integrated with the space, and ceased to be "a cross between a souvenir shop and a museum," as mentioned in the magazine *Arkitekten* (qtd. in Salo-Matttila 2000, p.77). However, for the 1939 Exhibition in New York, Aalto had everything under his control. The commissioner, who was his schoolmate, William Lehtinen, was considerate as well. Aalto designed an organic, undulating wall with embedded photographs, and the exhibited objects were displayed at the ground floor (fig. 122, 123). The Finnish forest industry and Finland as a modern country were the themes of the pavilion, and Aalto succeeded in demonstrating these factors in an integrated scheme (Korvenmaa 2009, p.106).



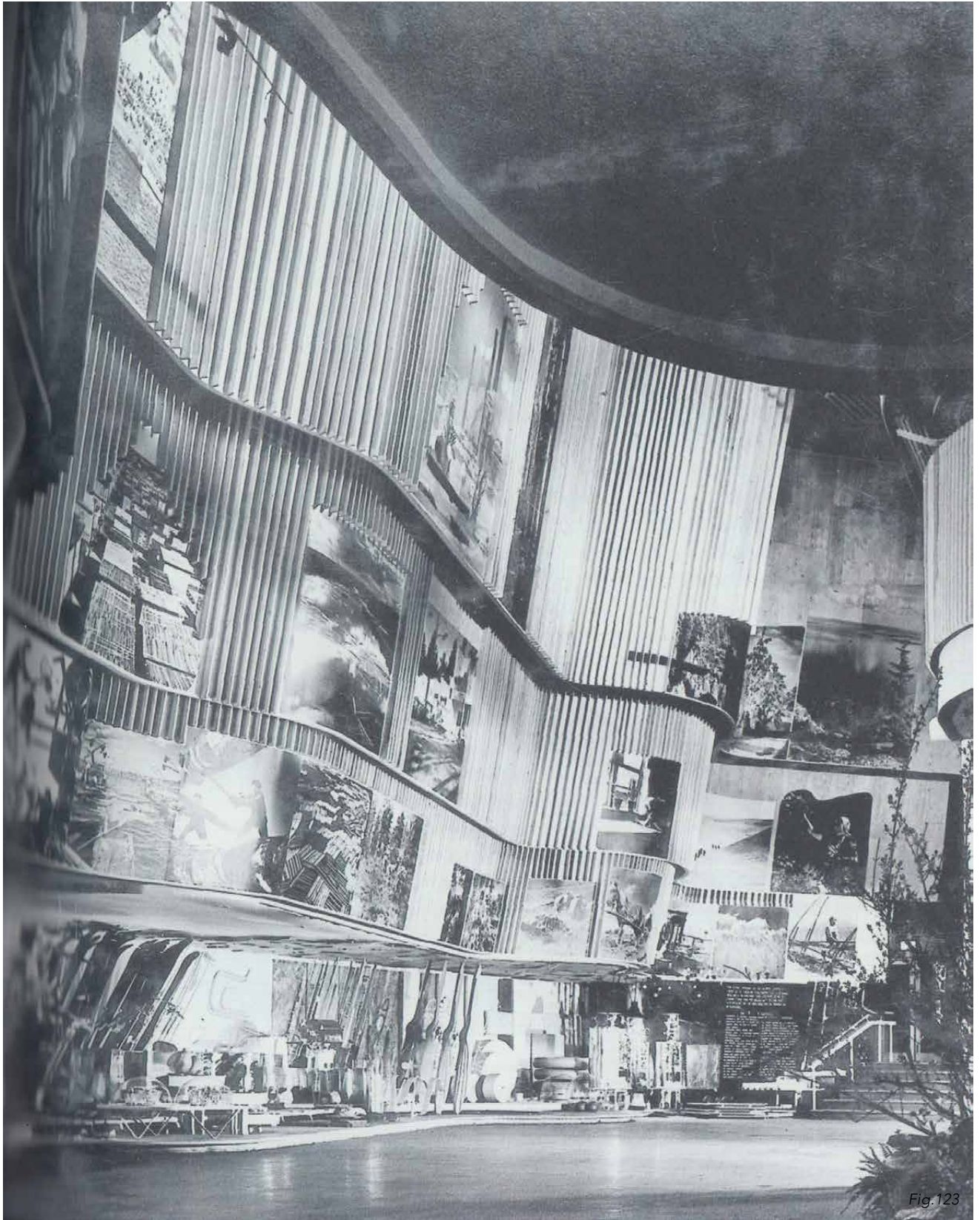


Fig. 123

Fig. 123 The Finnish pavilion for the New York World's Fair of 1939.

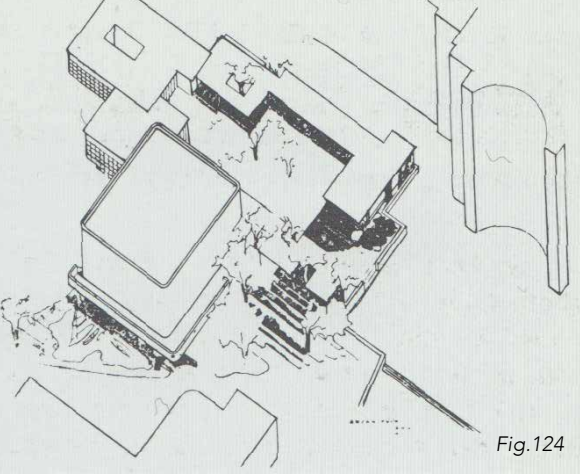


Fig.124



Fig.125

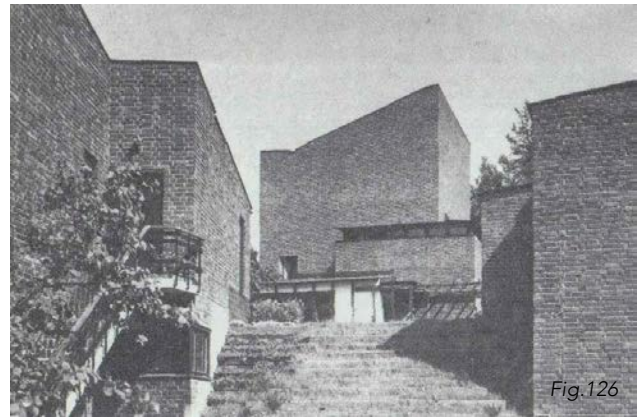
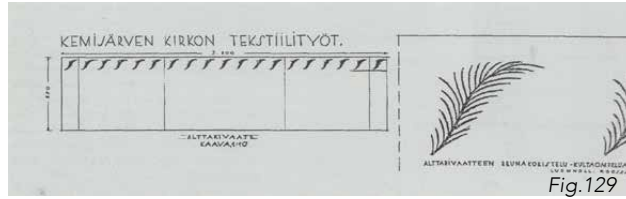
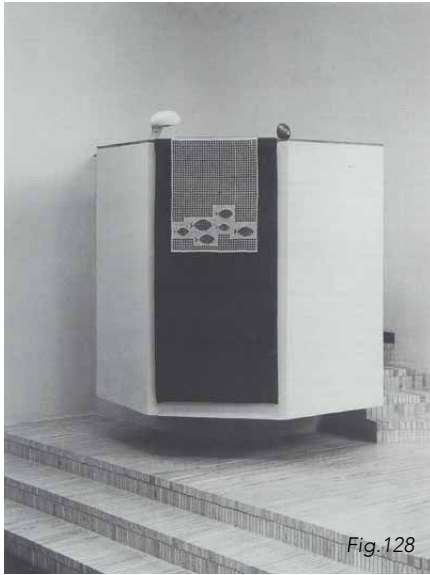


Fig.126

Above, left to right, Fig.124 Aalto, Finnish Pavilion, World Exhibition, Paris, 1937. / Fig.125 Alvar Aalto, Villa Mairea, Noormarkku, Finland. View towards the living hall. 1938-1939. / Fig.126 Alvar Aalto, Särnätsalo Town Hall, Finland. 1949-52. / Below, Fig.127 The poetic closing detail above the display wall.



Fig.127



Above left, Fig.128 Pulpit hanging in Vuoksenniska Church, 1959-60. / Above right, Fig.129 Design for the tapestry hanging for the Kemijärvi Church pulpit, 1929. / Fig.130 The curtain for the Turku Finnish Theatre was Aalto's largest and most ambitious textile work. / Below, Fig.131 Finlandia Hall curtain, produced by the studio of Dora Jung.

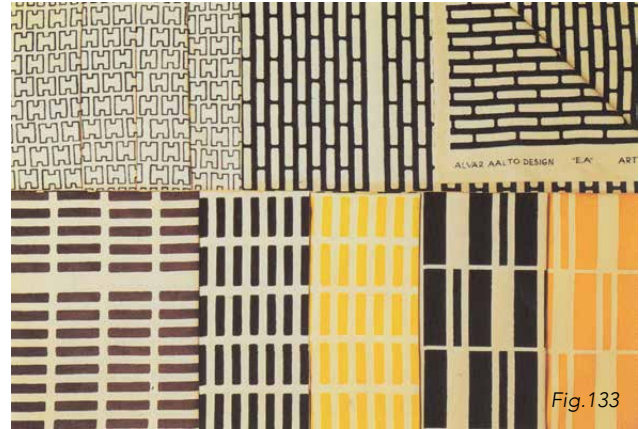


The earlier pavilion in Paris, however, was still a significant work in terms of Aalto's architecture (fig. 124). Aalto consciously designed the building so as to incorporate the movement of people into its spatial organization, creating "an intimate relationship between Man and Architecture," as described in his own words (qtd. in Frampton 1992, p.197). Frampton describes that this way of spatial design, where two elements are connected by human movement, is articulated further in his later major works, such as the Villa Mairea and Säynätsalo Town Hall (ibid.) (fig. 125, 126). Furthermore, Aalto was careful to consider the human needs in architectural space, for example hygiene, privacy, sun-screening, glare reduction, and acoustics. These factors are equal to the functions that textiles can have in architectural space, but Aalto often solved or lessened these problems with actual architectural segments. For example, in the Villa Mairea, the waving detail above the shelves of the library (the display wall on the opposite side) acoustically separates the two spaces, but also lets in poetic rays of light through (fig. 127).

Of course, actual textile materials were also present in Aalto's architecture. His textiles can be grouped into two categories, one consisting of site-specific textiles for buildings like churches and theaters, and the other consists of more commercial and functional textiles, including tablecloths and curtains.

Aalto designed many church textiles, such as the furnishings in the Church of the Three Crosses at Vuoksenniska and Seinäjoki Church (fig. 128). The textiles of the Kemijärvi Church were woven by Eva Anttila (fig. 129). For the Turku Finnish Theatre in 1928, Aalto designed an enormous textile piece depicting human figures from Classical drama (Schildt 1994, p.270) (fig. 130). Aalto did not design textiles as bold as this theater curtain afterwards. The curtain in the main auditorium of the Finlandia Hall is produced by the studio of Dora Jung, but she has mentioned Aalto's participation in the design work (Timonen 2007, p.149) (fig. 131). Jung fully exercised her textile skills to materialize Aalto's intentions. She referred to the architect's sketches of light and shade, which inspired Jung to design with various shades of grey.

The second category of the more "minor" textiles was, in fact, very prominent in Aalto's works. He has referred to them as a "substitute for living nature, for trees, flowers and grass, the presence of which people need



in interiors" (Schildt 1994, p.270). In cities that are detached from nature, Aalto saw the need to integrate textiles to create a homely environment. After Aalto shifted towards modernism, he softened his rational interiors with textiles of natural colors and textures (ibid.). For Aalto, textiles were also a medium with which he expressed his disagreement with technocracy.

However, like the other architects, Alvar Aalto is not the sole creator of his interior textiles. His wife Aino Aalto designed many textiles to match Aalto's furniture. From 1941 until her passing in 1949, she was head of Artek, the company that produced and sold Aalto's furniture. Whereas Aino's textile designs featured natural motifs such as waves and fruits (fig. 132), and she also designed fabrics out of paper yarn, Alvar's second wife Elissa produced simple structural patterns in collaboration with Alvar (fig. 133).

Overall, although Aalto did not use textiles in innovative ways in a spatial sense, he regarded them as important elements in his architecture, and his textiles were often produced in close collaboration with other designers. Moreover, Aalto's thoroughly designed projects leave a significant impression on us today. Interior architects became an ordinary profession during the 1940s, and undertook most of the interior design work, leading to a cease in *Gesamtkunstwerk* (Korvenmaa 2009, p.153).

Finnish Modernist Textiles

In an article in the journal *Arkkitehti* (The Architect) in 1977, it is stated that "one rarely sees a work of textile art and an architectural setting from a coherent whole" (qtd. in Priha 2001, p.85). However, this statement could have been specifically referring to the works during the time it was written. There have been several commissions of textiles for public spaces in Finland, and many have been integrated into the architecture. Especially during the recent decades, there has been an increasing number of cooperative works in the realm of textiles and architecture, and textiles are visible in public spaces such as libraries, theaters, and even outdoors (Poutasuo 2001, p.8).

In the 1920s, textiles were commissioned to accompany interiors of buildings. Eva Anttila (1894-1993) has created numerous works for specific



Left to right, Fig.132 Some of Aino Aalto's cretonne fabrics from the 1930s. Left to right: *kirsikka* (cherry), *lehti* (leaf) and *aalto* (wave). / Fig.133 In the 1950s, Alvar and Elissa Aalto designed a series of fabrics featuring simple structural patterns suitable for use as both curtains and tablecloths. Left to right, above: 'H 55' and 'E.A.'; below: 'Siena' and 'Pisa'. / Fig.134 Eva Anttila, "Work and Life." Tapestry. Woven by the artist. 1952. Shown at its present location at the Bank of Finland in Helsinki, Finland. / Opposite page, top, left to right, Fig.135 Eva Anttila, "Work and Life". Tapestry. Woven by the artist. 1952.Helsinki, Finland. / Fig.136 Dora Jung, the "gold wall" of "The Gold and Copper Standard", Bank of Finland, 1952. / Top to bottom, Fig.137 Greta Skogster-Lehtinen, birch-bark wall covering, 1942. / Fig.138 The Sokos department store in the center of Helsinki, designed by the architect Erkki Huttunen before the war. / Fig.139 Interior design by Olavi Hänninen for the Nissen café in the Industries Palace also known as the Palace building in Helsinki (1952).



Fig.135



Fig.136



Fig.137



Fig.138



Fig.139

sites. In 1924, Anttila was commissioned by Arttu Brummer-Korvenkontio to design a wall-hanging suited for the dining room of a private home. Johan Sigfrid Sirén was the architect of the Bank of Finland, which commissioned Anttila's largest piece, "*Työ ja elämä*" ("*Work and Life*"), created between 1949 and 1951 (Priha 2001, p.87) (fig. 134, 135). It is estimated that this work was taken into consideration when the marbled lobby was designed, meaning that the textile may have preceded the architectural space. Anttila's later works contained influences of Cubistic structures, and she created simultaneity and the illusion of transparency with the manipulation of textures and colors (Salo-Mattila 2000, p.72).

Another prominent textile artist in Finnish architecture is Dora Jung. Her work "*The Gold and Copper Standard*" of 1952 was also made for the Bank of Finland (fig. 136). Jung carefully studied the site, and placed the "gold wall" on the side for major clients, and the "copper wall," which is more smooth and warm, near the area for normal clients (Priha 2001, p.87). Jung also designed a stage curtain for Hanken, the Swedish-language School of Economics in Helsinki in 1953. With this work, Jung adopted a new technique of placing a drawing under the warps while weaving. The architect of the building Kurt Simberg has stated that he and his clients were inspired by Jung's positive way of working (ibid., p.89).

Besides public commissions, there were more experimental textile works that reflected the era. Greta Skogster-Lehtinen (1900-1944) designed a wallpaper made of birch bark, grease-proof paper and paper string in 1942 (fig. 137). This unique use of materials resulted from the shortages of raw materials during the Second World War (Korvenmaa 2009, p.149).

Like other modernist architecture in Europe, Finland also began to construct buildings with large surfaces of glass. Commercial buildings like the Sokos department store and the Nissen café in Helsinki housed curtains that added movement to the sleek surfaces (fig. 138, 139).

Other Nordic Textiles and Architecture

Finland was under great influence of Sweden, both politically and culturally. The neighboring country also developed textile concepts in architecture, and will be briefly introduced here, since they are most likely



Fig.140



Fig.141



fig.142

to have influenced Finnish design.

Alvar Aalto was influenced by the Swedish architect Gunnar Asplund. One of Asplund's most famous works is the Woodland Chapel, completed in 1920 in the Stockholm South Cemetery (fig. 140). This was a result of a competition entry with fellow architect Sigurd Lewerentz in 1915. The form of this Classical style Woodland Chapel was derived from a "primitive hut" that Asplund himself saw at a garden in Liselund in August 1918 (Frampton 1992, p.195, Blundell Jones 2006, p.67) (fig. 141). According to Blundell Jones, "[t]he informal landscape was based on the English principles of Capability Brown, but there was also a series of intimate little buildings with rustic columns and low-thatched roofs" (2006, p.67). Asplund translated the thatched roofs of Denmark into a shingled roof, and also borrowed its scale and intimacy (ibid.).

An innovative modernist weaver worth mentioning is Frida Hansen (1855-1931), who was also a teacher and founder of the Norwegian Weaving Society in 1897 (Troy 2006, p.48). Her tapestries around 1900 were structured so that warp threads of the background were left unwoven, creating a three-dimensional effect with lively flowers in the foreground (fig. 142). If used as a curtain against a window, soft light would seem to be transmitted from between the branches of the growing tree.

Also in Sweden, there were textile commissions during the 1920s. Maja Sjöström designed textiles for the Stockholm City Hall, and Carl Bergsten designed the furnishings of the Gothenburg City Theatre in 1930 (fig. 143).

Pernille Holm, a Danish textile designer, has affirmed the frequent use of textiles in Finn Juhl and Arne Jacobsen's architecture (Brorsen 2004, p.33). This was due to their constant thought towards the user. Arne Jacobsen himself also designed textile print-patterns and wallpaper, encouraged by his wife, when it was difficult to obtain actual architectural projects (Tøjner and Vindum 1994, p.44) (fig. 144). Furthermore, in the Royal Hotel finished in 1960, Jacobsen designed a wide range of textiles (fig. 145, 146).

Left to right, Fig.140 Gunnar Asplund, Woodland Chapel, Stockholm South Cemetery. 1920. / Fig.141 "The Swiss Hut" near the entrance to the park of Liselund. Half-timbered walls on a stone boulder foundation. / Fig.142 Tapestry by Frida Hansen (1855-1931). / Opposite page, top, left to right, Fig.143 Silk drapes designed by Maja Sjöström in the three crowns chamber, Stockholm City Hall. Image from between 1923 and 1930. / Fig.144 Hyacinth, Gouache, textile pattern, 1945. / Top to bottom, Fig.145 The interior of the Royal Hotel. / Fig.146 Arne Jacobsen's textile patterns for the Royal Hotel.



Fig.143

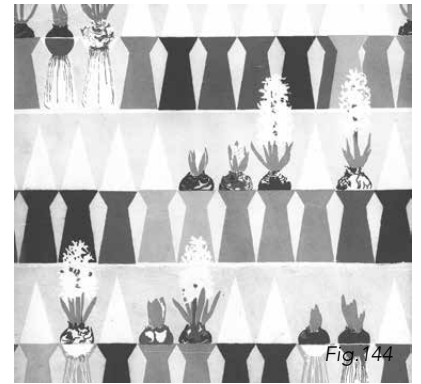


Fig.144



Fig.145

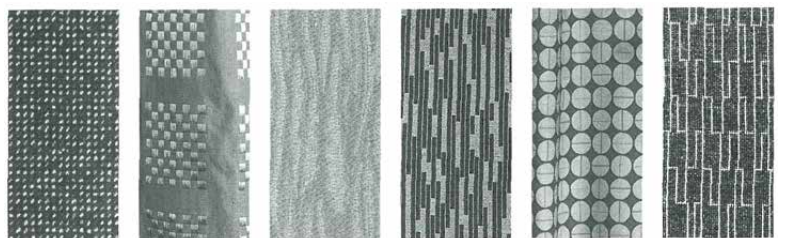


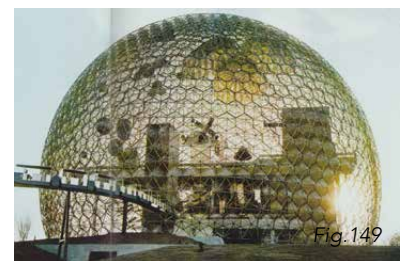
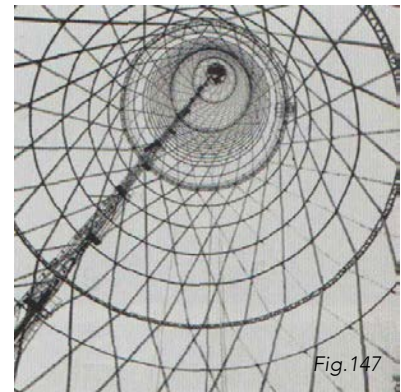
Fig.146

2.8 Textiles as Architecture

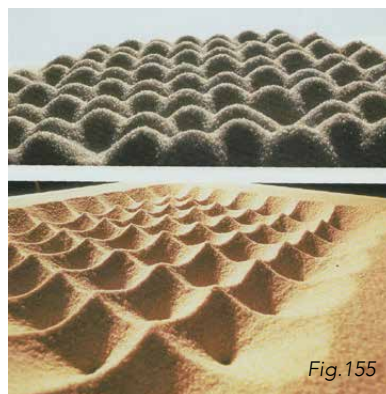
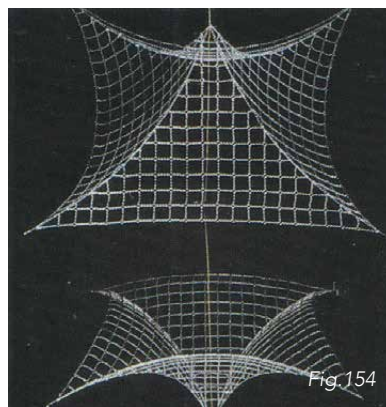
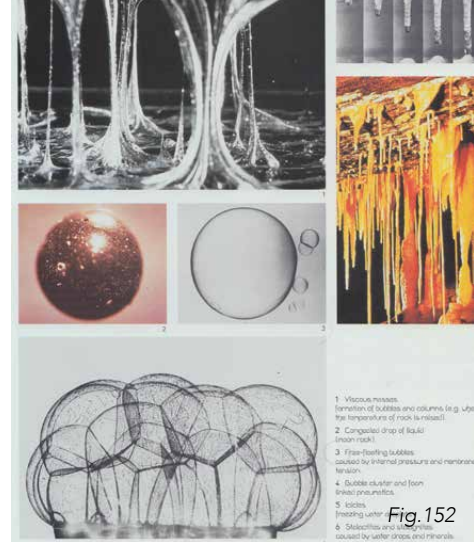
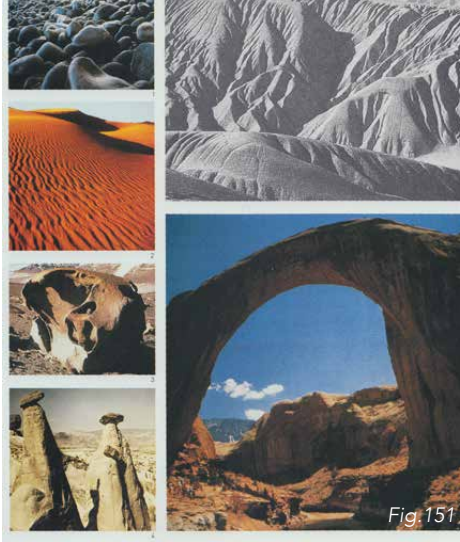
When speaking of architecturally integrated textiles, the most extreme and technically advanced outcomes are tensile and pneumatic structures. Due to the development of innovative materials and techniques, lightweight architecture has evolved from its ephemeral status to becoming a sustainable solution for various purposes. Technical textiles are more durable, efficient and lighter than ever. Although their main priority is functionality, architects have consciously utilized tensile materials to create spaces with aesthetic qualities as well. Therefore, within this thesis context, the design process and atmospheric potential of tensile structures will be selectively explored below. Details in specific technologies and fibers are thoroughly researched in books such as *Flexible Composite Materials* (Motro, ed., 2013) and *New Tent Architecture* (Drew, 2008). Furthermore, the Master's Thesis *Textile in Architecture* by Terhi Kuusisto of Tampere University of Technology provides a general overview from primitive tents to pneumatic structures, and also covers the basics of technical textiles.

Emergence of Lightweight Architecture: Frei Otto

“Lightness” and “nothingness” was a new and upcoming theme in modernist architecture. Mies van der Rohe and Philip Johnson proposed floating glass houses during the end of the 1940s. In Russia, engineer Vladimir Shukhov developed woven structures in architectural scale to create geodesic airframes during the 1930s (fig. 147) (Ramsgaard Thomsen and Bech 2011, p.13). A breakthrough was the geodesic dome by Buckminster Fuller. Fuller created various lightweight building types between 1954 and the early 1960s (Kronenburg 1995, p.46). However, precedents in dome structures existed before Fuller, such as the first planetarium projector by Dr. Walter Bauersfeld in Jena, Germany of 1922 (ibid.) (fig. 148). Fuller is credited for demonstrating domes as practical structures for buildings, and culminated his visions in the American pavilion at Expo '67 in Montreal (fig. 149). Here, hexagon shaped acrylic panes had filters that could be opened or closed according to the sun's direction (ibid.). In the early 1960s, Fuller proposed a utopian dome over Manhattan, which would envelop an artificial environment for times of



Top to bottom, Fig.147 Shukhov tower: in the radio tower Sabolovka from 1919, 6 hyperboloid structures are mounted on top of each other creating a 150 m high tower. / Fig.148 The geodesic dome structure created by Dr. Walter Bauersfeld on the roof of the Carl Zeiss works at Jena, Germany, 1922. / Fig.149 The American Pavilion with its automatically controlled blinds symbolized an optimistic future in which technology and nature belonged together.



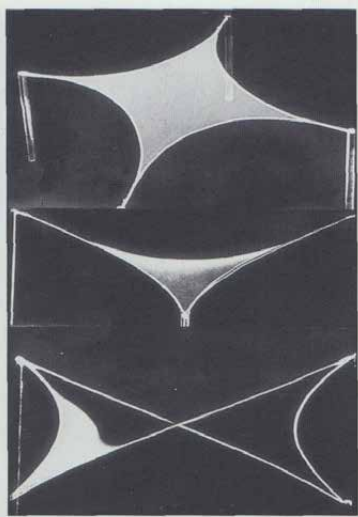
Top, left to right, Fig. 150 Fuller, project for a geodesic dome over midtown Manhattan (river to river, 64th-22nd streets), 1962. / Fig. 151, 152 Images from the catalogue "Frei Otto, Bodo Rasch: Finding Form." / Top to bottom, Fig. 153 Soap film, model for a tent. / Fig. 154 Suspended model of a square-mesh suspended net made up of triangular segments and its reflection. / Fig. 155 Funnels (above) and spoil cones in an even layer of sand. The holes are arranged in a regular pattern.

emergency (fig. 150) (Krüger 2009, p.146).

However, it was in Germany where progressive developments took place. Monumental styles such as Neoclassicism was tied to Hitler and the war period, and the country needed to bring forth a new, optimistic style in architecture. Frei Otto (1925-2015) was the leading figure in this new movement, integrating ideas of sustainability, technology, nature and aesthetics.

Before proceeding directly to Otto's works, it is worth looking into the formation process of his architecture. In 1992, an exhibition titled "Gestalt Finden (Finding Form)", the Werkbund shows Frei Otto, Frei Otto shows Bodo Rasch" was held in Munich, celebrating the Werkbund first prize Otto had received. Bodo Rasch is another architect working with tensile structures, and he worked in Frei Otto's office for a couple of years. The exhibition presented the starting points and working methods of the two architects, and can be understood today through the catalogue *Frei Otto, Bodo Rasch: Finding Form* (Schanz, ed., 1995). The catalogue first presents a vast number of pictures of different forms in nature. Sand dunes, water droplets, trees, and animal nests are all intriguing structures for the two architects (fig. 151, 152). Although Otto was conscious of primitive tents and huts, his inspirations were not limited to textile material, and for example he conducted soap film experiments to find forms for membrane structures (fig. 153). Other materials he experimented with are suspended chains, sand, and plastic-stiffened rubber films (fig. 154, 155) (Schanz, ed., 1995, pp.58-65). Furthermore, the soap film experiments are "far from dead," according to the Advanced Geometry Unit (AGU) (Simmonds, Self and Bosia 2006, p.84). Although existing on computer programs in virtual form, the analogy is still utilized and manipulated further to develop complex structures.

These experiments were enlarged so that they are



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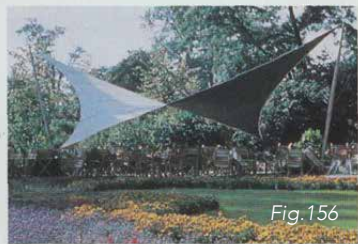


Fig. 156

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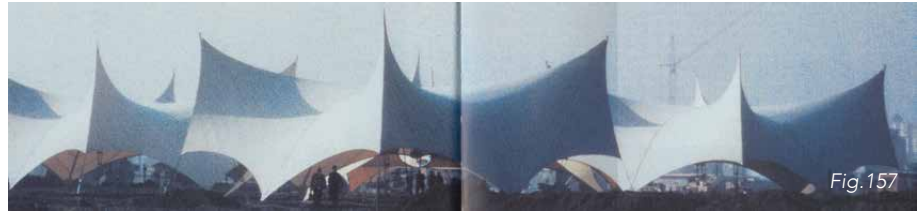


Fig. 157

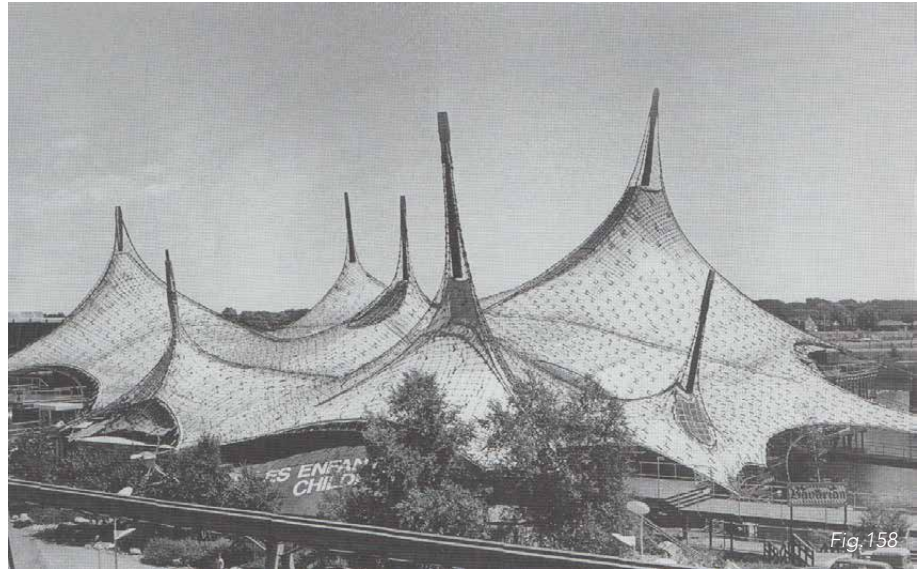


Fig. 158



Fig. 159



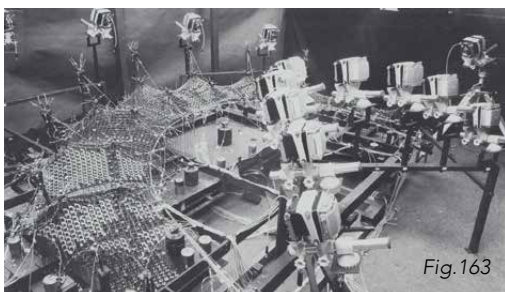
Fig. 160

Fig. 156 (above) Soap film of a four-point sail. (below) The four-point sail was pitched between two high and two low points as a music pavilion at the Federal Garden Exhibition in Kassel in 1955. / Fig. 157 Cross-wave tent membranes made of cotton fabric for the 1963 garden exhibition in Hamburg. / Fig. 158 Frei Otto and Rolf Gutbrod, German pavilion at the 1967 World Fair, Montreal, Canada. / Fig. 159 The completed net structure for the experimental building. / Fig. 160 For transport to the new site the net was loosened, folded from the edge and wrapped round the mast. / Opposite page, Fig. 161 Interior views of the institute. / Fig. 162 Olympic Stadium, Olympic Park Munich, Germany, 1972, Behnisch & Partners, Frei Otto, Leonhardt + Andrä. / Fig. 163 The large measurement model for the stadium roof. The models were built by Frei Otto and his team at the Institute for Lightweight Structures.



applicable in architecture scale. For example, the soap film experiment for a four-point sail is purely transformed into an exhibition tent in Kassel in 1955 (ibid., p.75) (fig. 156). Actually, all tent structures of Otto and Rasch can be created with soap film models (ibid., p.76). One of the most dynamic tent structures by Otto is the 1963 garden exhibition in Hamburg (fig. 157). It consists of four cotton cross-wave tents, and their elegant curves and shadows symbolize the features of the material itself.

Otto and Rolf Gutbrod submitted a proposal using a rope net construction for the German pavilion in Montreal in 1965. This building was planned and completed in only thirteen months, and its immense scale and unique shape was given attention worldwide (fig. 158). The net was made of steel ropes, and a PVC-coated Polyester fabric was suspended fifty centimeters below the net (ibid., p.96). The combination of these two materials enabled functionality that was more than sufficient, as the pavilion was not taken down for six years, whereas the initial plan was only for two. During its planning stage, an experimental structure was built on a university campus in Stuttgart-Vaihingen in 1966 (ibid., p.100) (fig. 159). Two years later, this experimental building was dismantled – the net removed and wrapped around the mast – and was re-erected in a different site (fig. 160). Although this structure covered only seventeenth of the area of the real pavilion, it still proved the inherent characteristics of tent structures: mobility and quick assembly. Furthermore, a glass façade surrounded the structure in its new location, and it operated as a research and teaching center for 25 years (fig. 161).



Otto created an even larger net wire structure for the Munich Olympic Games in 1972 (fig. 162). New methods of calculation and model experiments developed during its construction, and a building four times larger than in Montreal was erected (fig. 163). This time, acrylic glass panes were set inside flexible joints, creating a luminous space underneath.

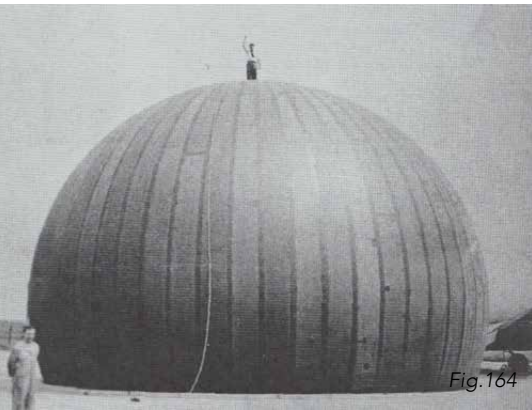


Fig.164

Left to right, Fig.164 First air-supported Radome, Cornell University Aerospace Laboratory, Buffalo, USA, 1948, Walter Bird. / Fig.165 Peter Cook's vision of Instant City Airships, 1970.

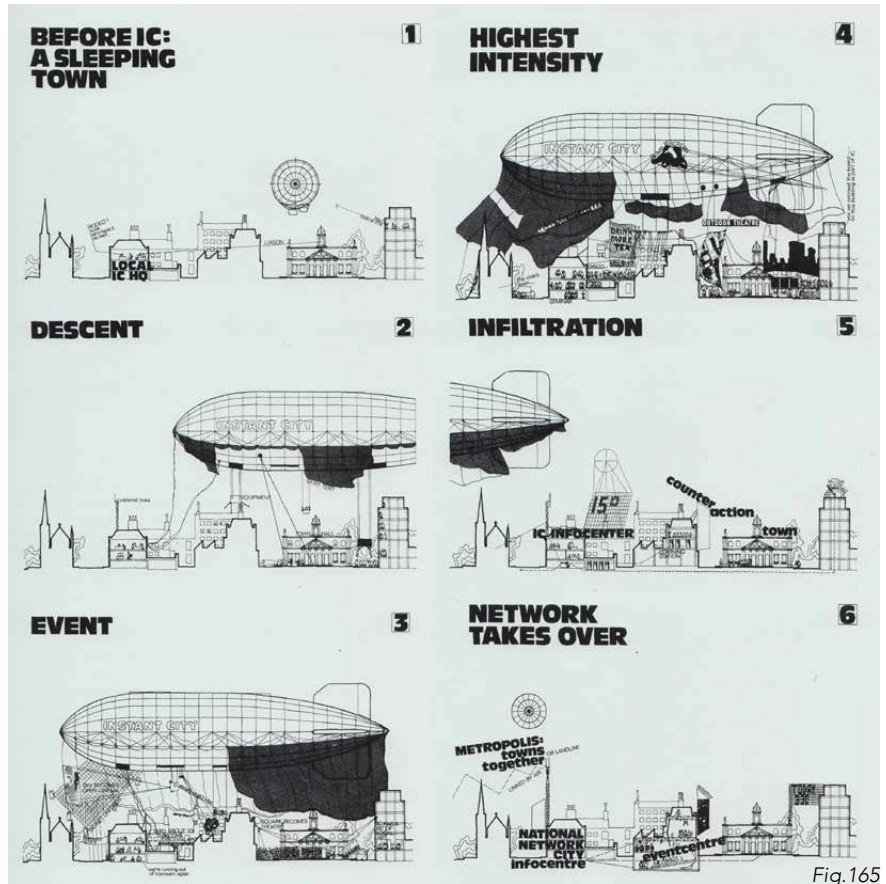


Fig.165

Pneumatic Structures

Pneumatic structures, which are tent constructions supported by air pressure, were developed by architects other than Otto as well. Actually, there are numerous precedents in this field, as textiles and air have often been interdependent to each other in structures such as sails, parachutes, kites and air balloons.

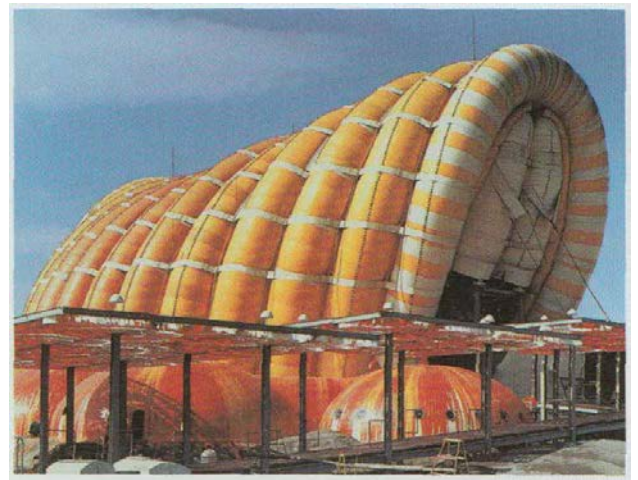
In the USA, Walter Bird developed pneumatic domes for radar stations as early as 1948 (fig. 164). The material was suitable for transmitting radar and radio waves without very little resistance (Krüger 2009, p.146). Frei Otto did not know Bird, but around the same time he started to develop inflated structures. His earliest aluminum membranes can be traced back to 1952 (Schanz, ed., 1995, p.115). Otto noticed the potential in pressured structures, as they did not need poles for support, leading to more spacious areas underneath.

While Bird's structures were purely functional, later on, architecture groups such as Archigram and Haus-Rucker-Co proposed optimistic visions for the future using textile architecture. Archigram consisted of mainly six architects based in London, and their Instant City idea of 1970 is initiated with a balloon that releases a canvas

over an existing city (fig. 165). The open spaces beneath the fabric become cinemas and theatres, and the initiated action continues after the balloon has left (Herwig 2003, pp.51-55). The Austrian Haus-Rucker-Co created a transparent residential bubble called "Oasis No.7" on the Fridericianum in Kassel, Germany (fig. 166) (Krüger 2009, p.146). Built in 1972, an air compressor maintained the PVC skin.

Around the same time, realistic pneumatic structures reached a high point at the Expo 1970 in Osaka, Japan. Examples such as Yutaka Murata's Fuji Pavilion took new forms in the realm of pneumatic architecture, and sixteen curved tubes were animated with projections inside (ibid.) (fig. 167). Even umbrellas, which have been used since ancient times in Egypt and the Orient, were enlarged and inflated at the Osaka Expo (fig. 168).

Overall, pneumatic structures are often associated with utopian theories and explorative expositions, and although many have encountered failures due to weather conditions, developments have enabled their further use in modern society.



Top to bottom, Fig.166 Haus-Rucker-Co, Oasis No.7, Kassel, Germany, 1972. / Fig.167 Yutaka Murata. Fuji Pavilion, Expo 1970, Osaka, Japan. / Fig.168 Tanero Oki. Pneumatic umbrellas, Expo 1970, Osaka, Japan.

2.9 Japanese Spatial Textiles

The above discourse throughout Chapter 2 is based on developments in Western culture, where masonry was the basis for permanent architecture. Cold surfaces were softened with use of textiles, and these fabrics later evolved into decorative wall hangings and draping. The culture of interior decoration as we know of today is of Western origin.

Meanwhile, Eastern culture developed its own textiles for architectural use. The unique spatial effects achieved in Japanese architecture are especially worth mentioning in this thesis context. Below, the most exclusive examples regardless of time are introduced.

Traditional Japanese Architecture: Fluidity and Vagueness

After Japan opened its doors to the outside world in mid nineteenth century, its culture was exposed to Western countries. It was nothing like what the Westerners had practiced until then, and was influential in many dimensions.

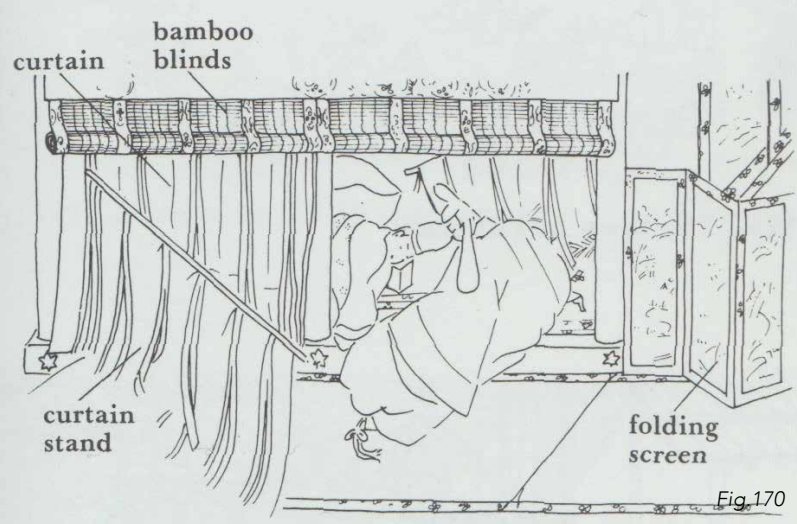
One of the largest surprises was inevitably the fluidity of Japanese architecture. This is achieved by the basic structure of traditional architecture, the post and lintel system. The skeleton composed of these two elements support the entire structure, and allow either large or subdivided spaces inside. Besides fixed walls, there are non-bearing mobile screens along built-in rails, and also free-standing screens (Nishi and Hozumi 1985, p.10). Screens, windows and sliding doors are assembled in various ways, according to the occasion or season, creating rhythmic surfaces. Furthermore, these lightweight spatial dividers allow maximum airflow through the humid interiors. Paper screens and also bamboo blinds allow a diffused light to enter, creating the unique atmosphere of Japanese architecture.

The multi-layered spatial organization also contributes to a similar diffusion. The distinction of inside and outside is often very vague, as there is usually a veranda or corridor serving as a transitional space (fig. 169). The light gradually dims as you go deeper into a Japanese building. In the phenomenal essay “In Praise of Shadows” (*In’ei raisan* 陰翳礼賛), Jun’ichiro Tanizaki discusses the Japanese aesthetics of diffused light and deep

Opposite page, Fig.169 The engawa, or veranda of a mountain refuge in Kyoto.



Fig. 169



darkness.

The specific elements and materials used in traditional architecture varied according to the different periods. For example, an abundant use of spatial textiles and other dividers is apparent in the *Shinden* (寝殿) style architecture. None of the buildings exist nowadays, but their rich interiors are depicted in narrative picture scrolls, called *emakimono* (絵巻物). In the Shinden style, bamboo hangings (*sudare* 簾) were hung close to the exterior, and certain curtains (*kabeshiro* 壁代) were often placed behind them (fig. 170) (ibid., p.67). The built-in screens in interiors were often painted (fig. 171). They are presently called *fusuma* (襖), but used to be termed *shoji* (障子). *Shoji* now refers to white paper screens, which became common in Shoin-style homes, described below. Actually, however, mobile screens and curtains were more frequently used than *fusuma*. Folding screens are called *byōbu* (屏風), and pieces that do not fold are called *tsuitate* (衝立) (fig. 172). Actual textiles were used as curtain stands (*kicho* 几帳) and hanging tapestries depicting Chinese or Japanese style scenes (*zejou* 軟障) (ibid.) (fig. 173). These dividers did not protect the inhabitants from cold, however, and aristocrats wore many layers of clothing to keep warm.

Fabrics were used in commoner housing as well. Pictorial sources give us an idea of the ordinary dwelling of the Japanese during the late Heian period, around twelfth century. The row-house was common around this time. "Walls were made of woven strips of bamboo or thin wood, and partially planked. Short curtains (*noren* 暖簾) hang over the entrance" (ibid. p.68). *Noren* was also abundantly used for commercial buildings, and is still used at some restaurants and stores today (fig. 174).

In addition to the noticeable examples above, there are also various textile-like aspects, such as patterns and woven structures, within traditional

Opposite page, left to right, Fig.170 Shinden interior.
 / Fig.171 Sanraku Kano. "Botan-zu" (Image of Peony)
 on fusuma screens in Daikakuji temple, Kyoto, Japan.
 / Right, Fig.172 The "zejou," or hanging tapestries
 of the Kyoto Imperial Palace. / Below, Fig.173 "Toto
 Odemmacho Han'ei no Zu" (Odemmacho Quarter
 image) with draped noren. / Bottom, Fig.174 Different
 noren seen in modern times. From left to right: Noren
 of a restaurant in Shimabara, Kyoto; Noren of the public
 bath; Takenoren, noren made of bamboo, Kyoto; Kaga
 noren of Ishikawa, Kanazawa.



Fig.172



Fig.173



Fig.174

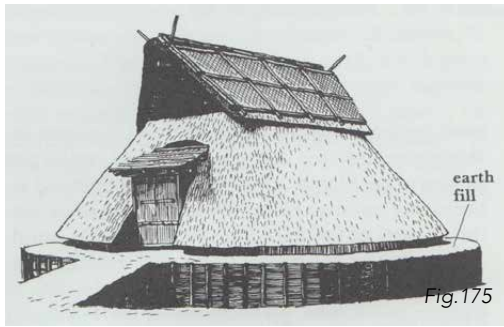


Fig.175



Fig.176

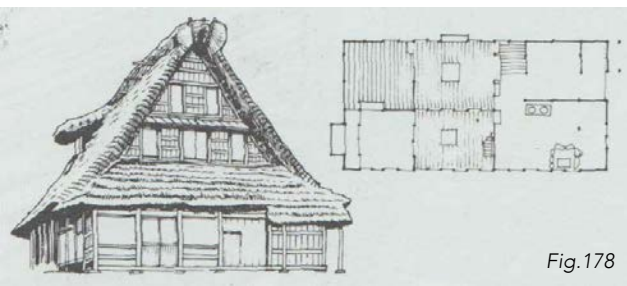


Fig.178



Fig.179

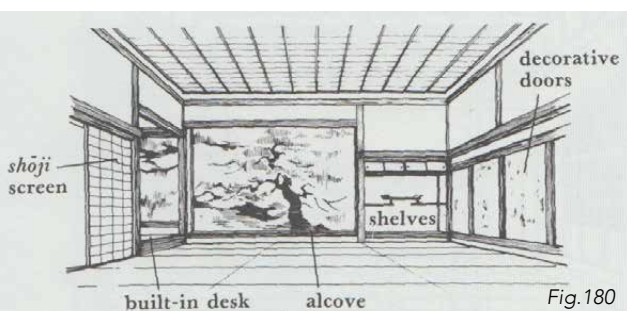


Fig.180

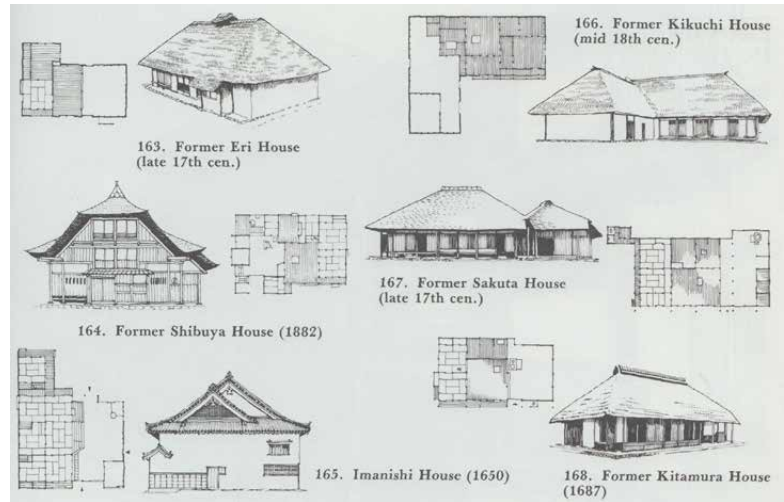


Fig.177

Japanese architecture. The thatched roof is one example. Even the earliest type of housing in Japan, a pit dwelling called *tateana jukyo* (竪穴住居), consisted of a round pit with a steep thatched roof on top (ibid. p.54). A pit dwelling of the Yayoi period had a roof that was thatched with miscanthus or some other grass (ibid.) (fig. 175). During the medieval period, Japanese style temples like Chojiuji had thick, low roofs (fig. 176). Various styles of *minka* (民家), or private houses, developed according to its climate, resulting in a variety of roof structures (fig. 177). The *gassho* (合掌, meaning prayer) structure found in Gifu and Toyama prefectures is named for its steep roofs, whereas the Kudo style found in Saga and Nagasaki prefectures in the south has a U-shaped plan (ibid., p.85) (fig. 178, fig. 179).

The Shinden style developed into the *Shoin* (書院) style during the Muromachi period (1338-1573) (ibid., p.74). *Shoin* means “writing hall,” which is a room used by abbots for studying and speaking. *Shoin* style features developed from the abbot’s quarters, and also from the *kaisho* (会所) hall of Shinden architecture. The *Shoin* style had four basic elements: a decorative alcove (*tokonoma* 床の間), staggered shelves (*chigaidana* 違い棚), built-in desk (*tsukeshoin* 付書院), and decorative doors (*chodaigamae* 帳台構え) (fig. 180), but not all *Shoin* buildings contained all four (ibid.). In the *tokonoma*, a painted silk scroll would often be hung. Another characteristic of this style was the use of the *fusuma* screens as interior spatial dividers, and *shoji* screens of white paper and wooden lattice as exterior partitions. Sliding panels called *amado* (雨戸) were set in front of the *shoji* to protect it from harm. *Fusuma*, *shoji* and *amado* are all still used in Japanese-style rooms in contemporary houses. The *shoji* consists of pressed rice paper or mulberry paper, and the wood frame is often made of softwood, such as clear pine, fir, redwood, cedar, Alaskan cedar, or port or ford cedar. The tracks on which the *shoji* slides can be made of hardwood, such as ash, maple, birch, or oak. There are also aluminum tracks, which are cheaper but are less durable (Nielson 2007, p.303).

Furthermore, the formal *Shoin* style led to the creation of a more modest and intimate style. This *Sukiya* (数寄屋) or *Sukiya Shoin* style merged the atmospheres of the tea ceremony and of the former elegance of the *Shoin* style. *Sukiya* often consisted of unique details such as ogee-arched windows (*katoumado* 火灯窓) and latticework (fig. 181). For example, the latticework of the transoms of the *Kuroshoin* of Nishi Honganji temple

Fig.175 Restored Yayoi pit dwelling in Toro, Shizuoka Prefecture, Japan. / Fig.176 The Hondo (main hall) of Chojiuji temple, Koka district, Shiga prefecture, Japan. Kamakura period (1185-1333). / Fig.177 Various styles of minka. / Fig.178 Former Emukai House, mid eighteenth century, in the Gassho style. Originally located

in the village of Kamitairamura, Toyama prefecture, Japan. / Fig.179 Typical Kudo-style house in Taku, Saga prefecture, Japan. / Fig.180 Joza no ma of the Kojoin Guest Hall, Onjoji, an early-period Shoin building. / Fig.181 Ogee-arched window of the Kuroshoin of Nishi Honganji. / Fig.182 The transom in the Kuroshoin of Nishi Honganji. / Fig.183 Garden of Zangetsutei and Fushin'an teahouses (left) and its elements (right). / Fig.184 The woven wooden strips (*ajirogumi* 網代組) on the ceiling of the Sumiya. / Fig.185 Design elements in the Sumiya.

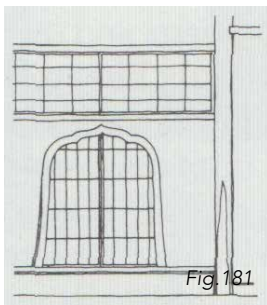


Fig.181

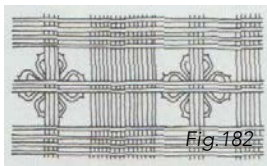


Fig.182

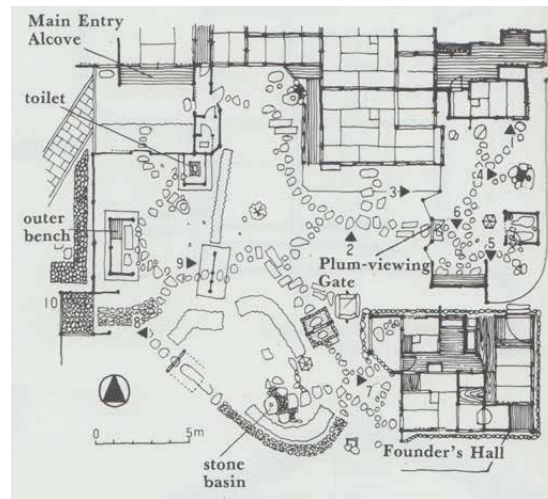


Fig.183

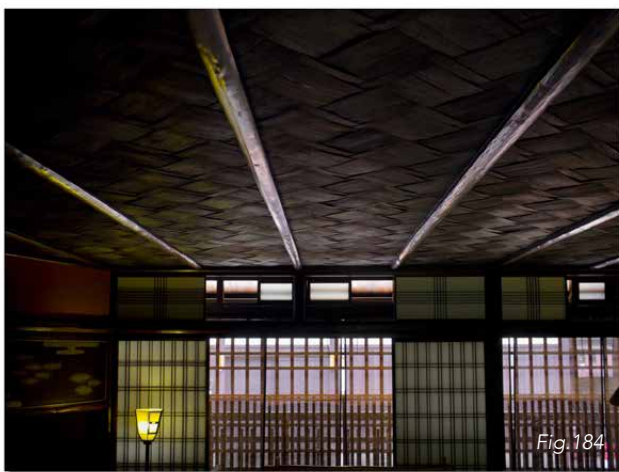


Fig.184

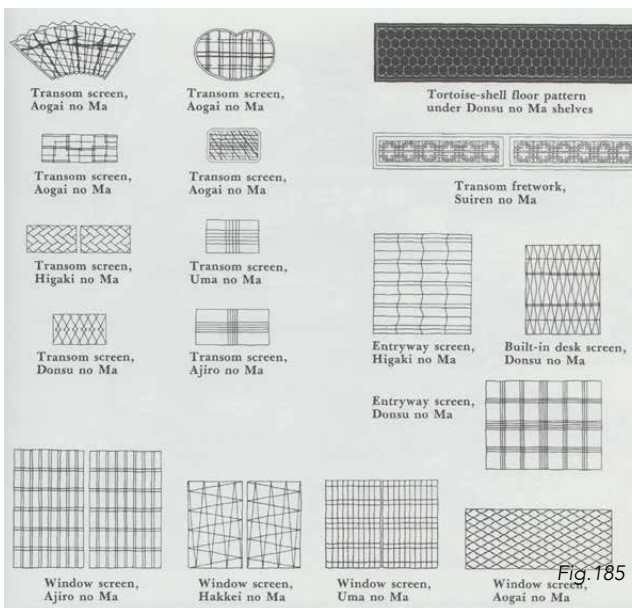
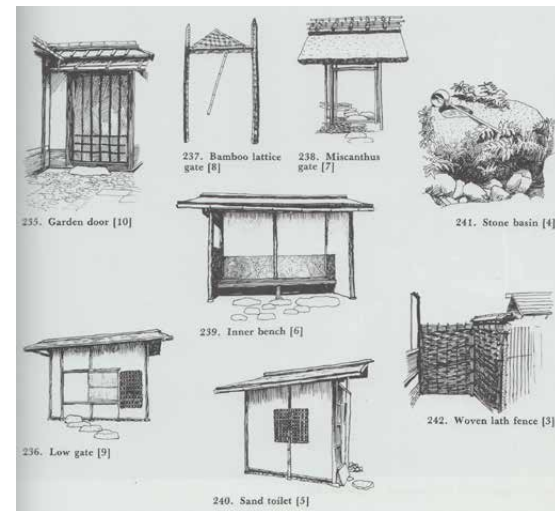


Fig.185

depicts textile-like structures in great detail (fig. 182). Such details are combined with the more humble surfaces, creating a balanced feel.

A prominent spatial experience related to Japanese architecture is surely the tea garden. Not only were tea ceremonies important, but also the route you took to the tea house was designed with care. Each garden creates its own story. When following the circulation of the Zangetsutei and Fushin'an teahouses in Kyoto, various structures come into sight; the lattice of the garden door, the wattled window, the bamboo lattice gate, a miscanthus roof, a woven lath fence (fig. 183) (ibid., p.119). The complexity of the human experience of interweaving these elements is what makes the tea ceremony experience so unique and incomparable to any other tradition.

Last but not least, the Sumiya in Kyoto demonstrates a visionary type of Sukiya architecture. Rich details adorn its surfaces, such as the woven wooden strips (*ajirogumi* 網代組) on the ceiling, artistic lattice patterns of the shoji, and walls adorned with mother-of-pearl (fig. 184) (ibid., p.129). The variety of screens and transoms is spectacular, differing in each room (fig. 185). Sumiya is the only "pleasure house" that is still visible today, close to its original form.



Fig.186 Japanese style patterns on western curtains in a modern Japanese style room.

Textiles in Modern Japanese Architecture

The unique culture of the Far East influenced the Western world, but at the same time American and European culture was introduced to Japan. During the Meiji era, Western architecture and lifestyle gradually spread, bringing great developments in education and industry. At the same time, however, traditional styles became less and less common. Although there are still homes with tatami mats and shoji screens, most rooms nowadays have Western furnishings. Styles of Japanese-like Western interiors or vice versa has emerged as well, but often lack the true sense of Japanese aesthetics (fig. 186).

As explained in Chapter 2.6.3, Modernism architecture also developed in Japan. Architect and historian Terunobu Fujimori states that Japanese architects of the twentieth century have mostly avoided the use of textiles (Fujimori and Yamaguchi 2013, p.203). However, one architect is known to have been keen on textile material: Togo Murano.

Togo Murano is a Japanese architect born in 1891. He is known for his modern interpretation of the Sukiya style, and was responsible for over three hundred completed projects ("Togo Murano"). Murano was so interested in textiles that he enjoyed seeing the newest obi fabric – used for wrapping the waist when wearing the kimono – in department stores during his lunch breaks (Fujimori

and Yamaguchi 2013, p.203). He was fond of using textiles in his interiors, and many of the surfaces in his architecture reflect the textures of fabric. One example is the Yatsugatake Museum in Nagano prefecture of 1979 (fig. 187). White lace fabrics of four times the surface area of the ceiling are richly draped, creating soft canopies in the exhibition rooms. They diffuse the artificial light that is irregularly embedded in the domed ceiling, creating a complex surface. Murano was sensitive to the usage of natural and artificial light, and he made sure that the architecture does not collide with the surrounding nature. The Yatsugatake Museum consists of interior space only, in that lightness, darkness and distance are the only elements that characterize the building (Ishida 2007, p.13). The spatial sequence and textiles are playing an important role in realizing this phenomenon. More ordinary curtains and upholstery fabric also play important roles in Murano's architecture. One of his last works, the Tanimura Museum in Niigata prefecture, consists of curvaceous walls that imitate the softness of textile material (fig. 188). The rounded edges of the exterior also look as if a fabric was draped over various shaped volumes (fig. 189). Furthermore, glassy, translucent fabrics cover the windows in the interior, allowing a sensual light to seep in (fig. 190).



Fig.187

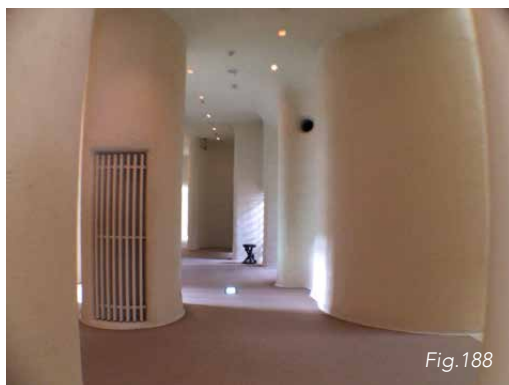


Fig.188



Fig.189



Fig.190

Top, Fig.187 Togo Murano. Yatsugatake Museum, Nagano prefecture, Japan. 1979. / Left to right, Fig.188 Togo Murano. Interior of Tanimura Museum, Niigata prefecture, Japan. / Fig.189 Togo Murano. Exterior of Tanimura Museum, Niigata prefecture, Japan. / Fig.190 Curtains in Tanimura Museum, Niigata prefecture, Japan.

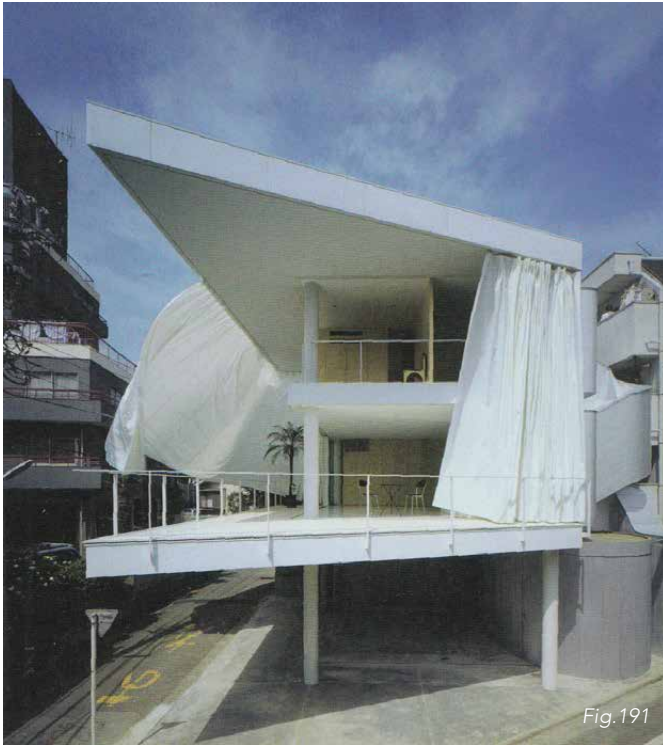


Fig.191

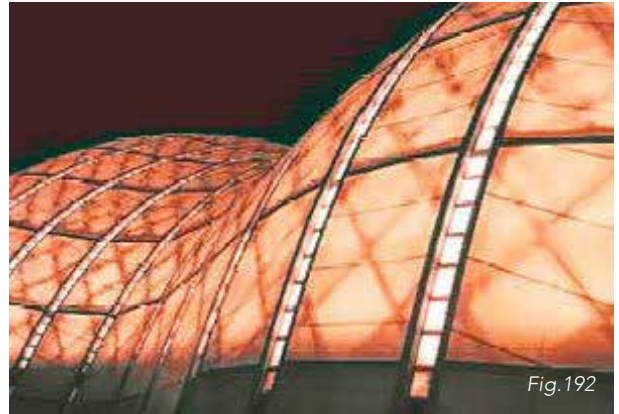


Fig.192

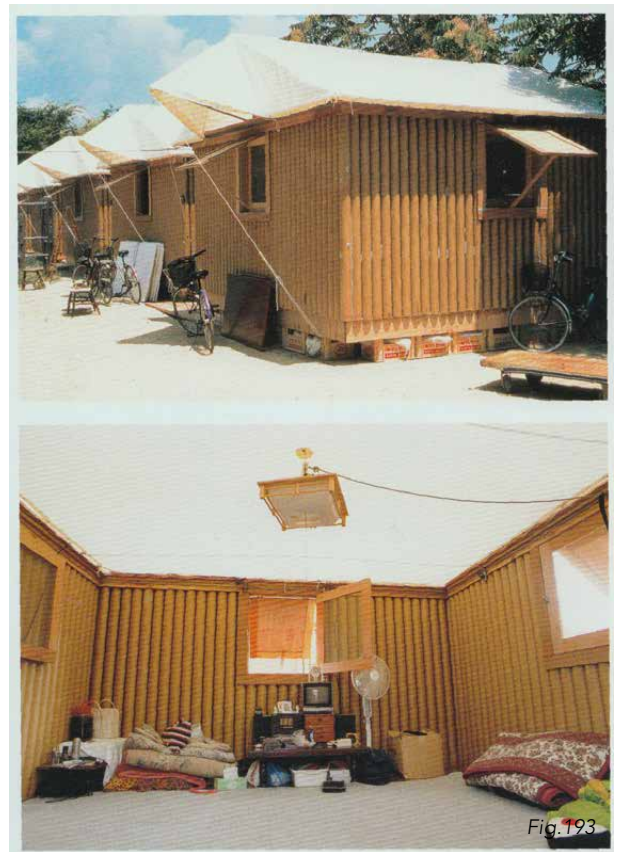


Fig.193

Finally, it is needless to say that Shigeru Ban's Curtain Wall House is a milestone in textile architecture (fig. 191). In 1995, it presented a contemporary answer to modern architecture with the use of actual textile material. Here, the glass curtain walls cherished in Modernist architecture were substituted with fabric curtains. The interiors are exposed, and with the movement of the immense curtains, a strong sense of liberation is fully expressed. Ban has proposed many other buildings using flexible materials such as paper and cardboard, like the recyclable Japanese pavilion of Expo 2000 (fig. 192) (Herwig 2003, p.105). He has also designed emergency housing out of these materials, and the translucency of fabrics has contributed to creating comfortable spaces for people in need (fig. 193).

Overall, Japan's climate and tradition has led to a diverse development in fluid architectural spaces, which have often been combined with textile material. This unique sensibility is still recognizable in contemporary works, further discussed in chapter three. I believe that the characteristics of textiles will continue to suit the architecture and environment of Japan, and innovative solutions will be further developed in the future.

Top left to right, Fig.191 Shigeru Ban Architects. Curtain Wall House, Tokyo, Japan. 1994-1995. / Fig.192 Shigeru Ban, Japanese Pavilion at Expo 2000 in Hannover. / Fig.193 Shigeru Ban, Paperlog Houses first used for victims of the Kobe earthquake in 1995. The walls seem solid and reliable, the translucent ceiling gives a sense of relative spaciousness that cuts against the size constraints imposed.

Chapter Summary

Chapter 2 explored examples and solutions from the past, and how textiles had different functions according to human needs and certain characteristics and styles in architecture. Since buildings and humans are not the same ones of the past, these examples may not be directly applicable to contemporary architecture. However, the way textiles were used reflect the needs of certain time periods, and were in many cases practical. As there was less or no high technology, solutions were developed with limited resources. Inspirations can be found in these approaches that designers and architects took, as more must be made out of less in the future. In other words, by looking back in time, hints for sustainable textiles and architecture are likely to be found.

3 Textile Roles in Architectural Space

Introduction

Today, textiles have numerous roles in architecture. Technological and material developments have led to the production of highly functional textiles that are more durable and further increase the comfort of spaces. On the other hand, the effects of textiles on atmospheres and the inner senses of humans are also attracting more and more attention. As Coles and House confirms, environments should not be created solely for practical reasons, but “just as importantly, [environments] also cater for those less-easily defined aspects of human existence: the desire for emotional sustenance and for meaning” (2007, p.170).

Moreover, textile functions are further enhanced when they are designed based on the site at which they will be placed. The increasing amount of collaborative projects enables these site-specific textiles to be produced. These textiles are ideal elements for enhancing architectural space. Though, when a designer works with three-dimensional space, he or she will have to consider multiple aspects, not only the design of the fabric itself. Larger spaces, for example public and commercial spaces, are often more complicated. Working as a textile designer and creative director, Maarit Salolainen stresses the difference “when it’s about public space and about big quantities” (2015). Problems not encountered in small-scaled pieces, such as furniture or even small curtains, can suddenly become prominent when you deal with large spaces.

This chapter will introduce recent projects utilizing textile elements in innovative spatial ways. By reflecting on both recent developments and historical examples, the future of textile developments in architectural space will also be forecasted. To gather relevant information from the actual working field, nine expert interviews were conducted. The interviewees are listed below, grouped in their working fields and in order of last name (fig. 194):

Textile artist and designer

- Outi Martikainen (FI)
- Kristiina Wiherheimo (FI)

Textile designer and creative director

- Maarit Salolainen (F&F (IN), Lauritzon’s, FI)

Textile development and creative director

- Päivi Grönqvist (Eurokangas Oy, FI)

Textile application innovator

- Samira Boon (Studio Samira Boon, NL)

Interior architect

- Jukka Halminen (KOKO3, FI)
- Tiina Rytönen (JKMM Architects, FI)

Architect

- Tiina Parkkinen (Berger + Parkkinen Architects, AT/FI)
- Mikko Summanen (K2S Architects, FI)

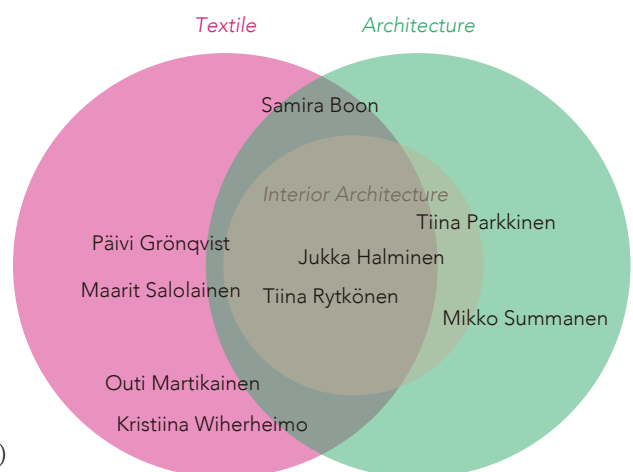


Fig.194 Professions of interviewees.

In addition, awareness of sustainability is inevitable within this discussion. Textile developments are constantly under the pressure of new legislation and environmental issues. New textiles, no matter how innovative and beautiful, should not be produced without considering sustainability. This does not only denote the textile material itself; architectural space and all of its elements have profound effects on human life, altering the sustainability level. Architect Tiina Parkkinen states in an interview (2015):

...we are confronted with even bigger challenges... I think that this over topic of sustainability...is I think partly misused, or is not understood well, and it's something that will more and more be one of the main engines in design processes. That's something we have to consider very well, because if you just to the technical things that are possible today, or if you just insulate the buildings more and more, that can't be really the answer, because we don't really know yet what real sustainable building looks like, so that it's beautiful. ... It's more about how the building behaves to the surroundings, how the people accept the building, how the people accept the building perhaps so well that they are willing to change [their] lives also, to a more sustainable life. Because this is always the problem.

The perfect, sustainable answer in textiles and architecture is perhaps still a mystery, but designers must aim towards the right direction and constantly question their design process and decisions.

This chapter will first explain the basics of textiles in architectural space, divided into two categories: traditional interior textiles and technical textiles. Second, the different roles of textiles will be discussed in two sections. The

first section focuses on the functional and technical roles of textiles, which improve the physical qualities of built environments. The second section focuses on the aesthetic, emotional and atmospheric roles. These relate more to the inner effects on humans, which are more difficult to measure, and cannot be justified with one particular reason. As mentioned above, neither functional nor aesthetic roles can be omitted during the design process. According to the specific needs of the architecture, there can be emphases on particular roles. Overall, though, the roles should be balanced to achieve comfortable spaces.

Types of Textiles

Textiles can be categorized in many different ways, but one clear distinction can be made between traditional and technical textiles. Traditional textiles are “associated with concerns of appearance and comfort,” and the manufacturing processes are based on methods that have existed for many years (Giuli and Ferrari 2013, p.9). On the other hand, technical textiles emphasize the technical features and functional properties over the aesthetic and decorative concerns (ibid.).

Another way to group textiles is according to way of use. Textiles are now used in building interiors (residential and commercial), exteriors (architectural application), and clothing. Each group uses different ratios of traditional and technical textiles. Textiles in exteriors are dominated by technical textiles, whereas interiors still use many traditional textiles. Recently, technical textiles are increasingly utilized in interiors as well.

Basics of Traditional Interior Textiles

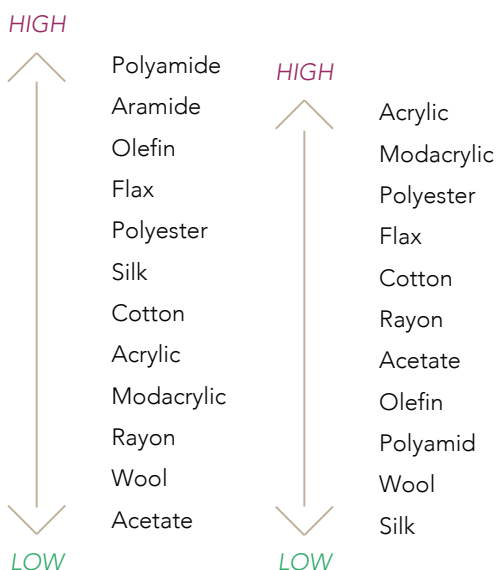
Textiles for interiors can be further categorized according to their place of application. Residential, home, or private textiles are used in houses, apartments, and other private residences (Yeager and Teter-Justice 2000, p.5). On the other hand, commercial, public, or contract textiles are often designed to sustain harsher levels of use, and used in public spaces and commercial buildings.

Interior textiles have specifications according to the parameters and requirements of a project. These specifications, or specs, assist the designer when selecting the appropriate material for the intended site. Below are some of the main parameters considered in interior textiles, based on Nielson (2007, p.112-114):

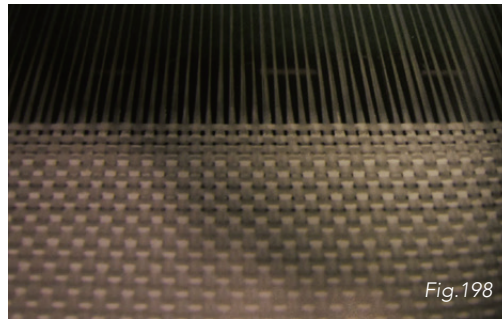
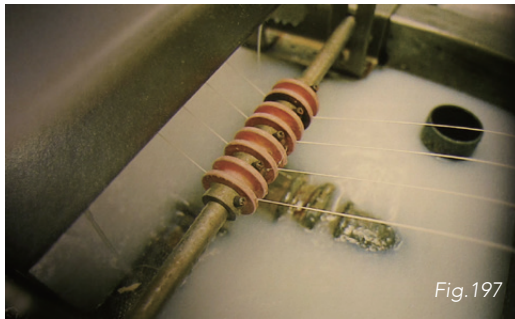
- o **Environmental requirements** include the ethical use of renewable resources, the protection of the earth's environment, and the specification of materials that will enhance rather than diminish the quality of life and air indoors.
- o **User or occupant requirements** are those that demand effort or resources on the part of the purchaser or user. They include the cost of materials, fabrication, and installation, as well as efforts in decision making, the longevity as well as physical and psychological comfort of the textiles, and upkeep or maintenance.
- o **Aesthetic requirements** concern the coordination of textiles as critical components of a whole interior or exterior private or public space. The long-term livability or aesthetic durability depends on several factors, including the performance of the fiber and textile construction, finishes, upkeep, the cycle of color trends, the timeless versus trendy choice of pattern, and the appeal of texture.
- o **Performance or functional specifications** are always present for textiles used in the public sector. They include flammability requirements, wet and dry crocking, colorfastness to light, physical properties, abrasion or crush resistance, and resistance to microbes or bacterial growth and moisture barrier.
- o A **descriptive specification**, in which the product is described in detail – including fiber content, construction method, weight, and so on, but without mention of manufacturer or jobber – is often used for textiles and carpeting.
- o **Fabrication specifications** are forms and written instructions, often accompanied by drawings, that are given to a fabricator whose job it is to custom upholster or sew textiles into the applications.
- o **Custom and installation specifications** may include drawings that show the style or shape or placement of the textile product. These may be floor plans, wall elevations, or product drawings.

Compared to technical textiles, there is a larger variety of materials and structures to choose from in the realm of traditional textiles due to less restrictions. Each material has their own properties, and they should be decided according to the level of requirements. Figure 195 and 196 show the tensile strength and light fastness levels of traditional fibers (Kozłowski, Kicińska-Jakubowska and Muzyczek 2009, p.23, 24).

Since textiles spatially associated with architecture are the main topic of this thesis, curtains are frequently discussed in the following sections.



Left, Fig.195 Tensile strength of fibers. / Right, Fig.196 Light fastness of fibers.



Left to right, Fig.197
Extrusion process of
a technical textile. /
Fig.198 Weaving process
of a technical textile.

Conventionally speaking, curtains or sheers are “relatively sheer, light-weight coverings that are hung without linings” (Yeager and Teter-Justice 2000, p.261). The term draperies or overdraperies describes the heavier, opaque fabrics that are often accompanied by linings. Casement is a term used for medium weight fabrics that has some degree of transparency (ibid.).

Although curtains generally look light and can be adjusted by hand, they can weigh more than expected. When applied in large-scale projects, “[a] curtain can occupy from 2 to 100 m² of architectural space in storage and can weigh up to 500 or more kilos” (Blaisse 2007, p.378).

There are also alternative and manufactured window treatments, such as shades and blinds, which are also made of materials other than textiles.

Basics of Technical Textiles

Technical textiles have quickly developed during the past few decades and found applications in various sectors. Not only are there new material developments, but also new manufacturing processes that have helped textiles to diversify usage realms. Due to the ongoing development, information about technical textiles in published literature quickly becomes old. Thus, this thesis covers the general information and standard materials that have been used in architecture.

Technical textiles develop from the need to improve its functionality and efficiency, and thus technical textiles require collaborative research between engineers, designers and users. To achieve maximum effects of the necessary function, specific materials and processes have been

developed solely for this field. Fibers for technical textiles can also be referred to as composite materials. Yarns are obtained by the extrusion of melted polyester granules or glass beads, which are woven together to create a “raw” fabric (fig. 197, fig. 198). This “raw” fabric is then coated, “usually of a PVC [polyvinyl chloride], silicone or PTFE [polytetrafluoroethylene, known as Teflon] base, enriched with chemical components such as dye, softeners, thermal stabilisers, antifungal agents or others” (Giuli and Ferrari 2013, p.11). Polyester fabrics are covered with PVC or silicone, and fiberglass fabrics are coated with PTFE or silicone (Drew 2008, p.32). Finally a surface varnish, which seals the surface to improve resistance to soiling, moisture and ultraviolet light, is applied (ibid.).

Ninety percent of membranes used in modern architectural projects are made of three types of technical textiles: PTFE-coated fiberglass, PVC-coated polyester, and ETFE (Ethylene-tetrafluoroethylene) sheet (ibid.). Besides these three main materials, there are other uncoated fabrics, micro-perforated membranes and low-emissivity (low-E) glass fabrics that are technically sufficient in certain projects. Spectra 900 is a new fiber material that is ten times stronger than steel but is light enough to float (ibid., p.33). Further discussion of weatherproof materials continues in Chapter 3.1.5.

Technical textiles also have cons, however, and research is continuously conducted to reduce waste in chemical treatment. Recyclability is also a pressing issue, and it is further expected that used material will not be down-cycled, but reused again in technical textile production. Technical textiles especially attract architects with the potential of becoming sustainable elements in architecture.

3.1 Functional and Technical Roles

The first group of roles explores the functional and technical aspects of textiles. Textiles have various properties that improve physical environments. They are useful when there are malfunctions in a building, which can be fixed by applying additional textiles according to the specific need. This has often been the case; textile designers are summoned to help after the completion of the building. However, with the growing availability of highly functional textiles, architects can choose to incorporate them into the architectural system. This simultaneous designing of building and textile can further improve the comfort in architectural environments. Textile specialists Päivi Grönqvist and Maarit Salolainen strongly stress the need of early initiations of collaborations:

...if everything is finished and the end user is picking up the curtains, it's just for the decoration, but if it's the architect who is specifying the fabrics ... it's always part of the architecture. And that's why I vote for ... the textile ... [to] be specified as early as possible so that it would be sort of a necessity in the building, and of course it is the warmth and it is the human thing ... but still it's also something else.

- Päivi Grönqvist, 2014

[Currently] the way to use textiles is more for decorative, so I would so much wish that it would go together again like it actually was in the beginning.

- Maarit Salolainen, 2015

To dispel the false notion that textiles are merely interior decorations, the following subchapters go over the many functions that are essential in architectural space.

3.1.1 Light Control

Basics of Light Control

[WHAT]

One of the most important aspects in architectural design is light. Textiles have long acted as sun-screening shades to improve comfort in buildings. Light control is increasing in importance due to large expanses of glass windows in contemporary architecture. Although glass allows spatial expansion and gives much visual freedom, glass also allows unwanted heat, ultraviolet rays and glare into interiors. These factors can have negative effects on both humans and objects inside.

Furthermore, outdoor light needs to be controlled in different levels according to the function of the interior. For example, theaters, assembly halls and museums all have certain reasons to prevent light from entering. Specific acts such as producing art and manufacturing are negatively affected in altering lighting conditions depending on the time of day. In any spatial design project, it is also meaningful to consider having a gradient between the brightest and dimmest spaces to prevent discomfort.

The quality and amount of daylight differs according to the orientation of the building, the proportion of the space and windows, and the surrounding buildings or trees (Coles and House 2007, p.142). Generally, “in the northern hemisphere, south-facing windows maximize the potential for sunlight capture and for thermal gain” (ibid., p.130). On the other hand, north-facing windows will not collect direct sunlight and will easily lose heat. Windows facing the east receive more light in the morning, whereas western faced windows receive more light in the afternoon (Yeager and Teter-Justice 2000, p.251). In the southern hemisphere it is generally the opposite. Therefore, it is natural for textiles to be designed or chosen during the building design process, since the way rooms, windows and curtains are placed is strongly interrelated with the final light effects. In addition, direct sunrays are not the only light sources. Light waves also radiate from the reflection of the sky, surrounding buildings and paved streets.

Light controlling textiles are both visually and functionally connected with the natural surroundings, providing as many different design possibilities as there are of environments. This is also related with the wide variety of sun-screening textiles, as different shapes and placements developed according to each climate. For example, in Europe, shutters and exterior blinds are sometimes installed from the very beginning, but in Nordic countries light is more valuable and not as controlled.

In addition, light needs to be controlled from the inside during

nighttime, as bright interiors are fully exposed to dark exteriors.

Light can also be harmful to the fabric itself. Prolonged exposure to sunlight or artificial light leads to the fading of colors and damaging of fibers. Figure 199 shows the sunlight resistance levels of different textile fibers, excellent meaning higher resistance properties (Yeager and Teter-Justice 2000, p.62). Brighter and darker colors tend to fade faster than lighter colors and neutrals (Nielson 2007, p.37). Dyes have different fading speeds, meaning colors can fade inconsistently. Therefore, an unexpected color can become dominant after time (ibid.). Window films and exterior shading systems can help protect textiles near windows.

[HOW]

Light control can be achieved in various amounts, according to the fabric structure and material. Textile structures determine openness, meaning the percentage of openings in the fabric. Furthermore, colors affect the amount of light a fabric reflects. Light-colored fabrics allow the least amount of radiant energy to be transmitted inside. For example, a white opaque shade can reflect up to eighty percent of solar energy, but a dark opaque shade can absorb eighty-eight percent of the energy and reflect only twelve percent (Yeager and Teter-Justice 2000, p.255, 256). However, white fabrics intended to shield off sunlight could instead become a bright light source, unexpectedly ruining the comfortable lighting of the interior (Rytkönen 2014).

Today's technical textiles have excellent solar protection qualities as well as being weatherproof. Coated fiberglass and coated glass mesh are also used in interior spaces. These composite materials can block up to ninety percent of incoming UV rays (Missakian, Nichols and Wong 2013, p.94).

In the realm of contract textiles, solution dyed acrylic is "the only fiber which actually is good ... with sunlight" (Salolainen 2015).

Traditional materials are also used to control light in interiors. Cotton, linen, silk, polyester, acetate and rayon are frequently used in residential settings, whereas wool, polyester, acrylic and modacrylic are more used in nonresidential buildings (Nielson 2007, p.184).

When sunlight needs to be wholly blocked, coatings and film sheetings are applied to drapery fabrics. A vinyl coating or sheeting is used for blackout curtains (Yeager and Teter-Justice 2000, p.295). Metallic-coated lining fabrics can act as light reflectors while simultaneously giving a dim-out, or partial blackout effect.

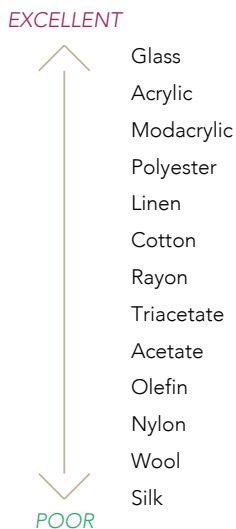


Fig. 199 Sunlight resistance of selected textile fibers.



Fig.200

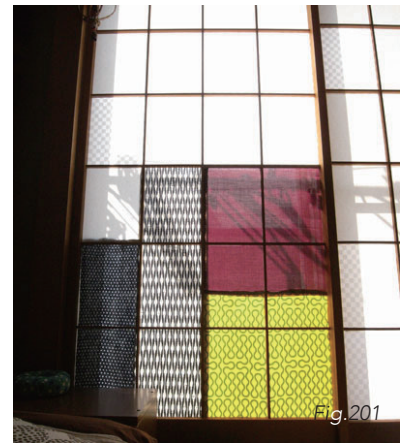


Fig.201

Examples, Details and Possibilities

1. *Traditional Japanese screens and variations*

As mentioned in Chapter 2.9, various movable sun-screening panels and textiles are integrated in Japanese architecture. They can flexibly be altered according to the needs in the interior and are designed also with sufficient ventilation properties.

The screen that is most often used, even today, is the *shoji*, which is a wooden lattice screen with Japanese paper (fig. 200). The light filtered through shoji screens is soft and warm and simultaneously contributes to preserving parts of darkness in Japanese architecture. Jun'ichiro Tanizaki describes in *In Praise of Shadows* that Japanese paper, or *washi*, “softly absorbs light rays like the soft surface of the first snow of the season” (1975, p.20). Material properties and aesthetic values are strongly interrelated in Japanese architecture, and perhaps that is why they are still appealing to this day.

One problem with shoji screens is that paper is very vulnerable to rips and tears. There are plastic coated screens that are stronger than plain paper, but the texture and softness of the Japanese paper is lost. When the paper has a tear, fabrics are sometimes used to replace it, resulting in modern DIY shoji screens with colors and patterns (fig. 201).

Not only the paper, but also the wooden lattice could be reconsidered with a different material for modern use. The wooden frames need appropriate railings to properly function; therefore, shoji screens cannot be installed to any kind of building. A soft, textile alternative to the shoji screen that has similar aesthetic properties could be beneficial to screen off strong rays in a wider range of environments. Although shoji screens are valued for their adjustability to allow plenty of airflow, they do not suit very cold climates. Textiles that are thin and translucent, but have high insulative values, could solve this problem.

Another more textile-like Japanese screen is the *sudare*, made of bamboo or reed (fig. 202). It is usually hung from the ceiling, but there are types that stand upright against the exteriors of a building as well (fig. 203). Their ability to shade off sufficient amounts of sunlight as well as letting air through between the weaves is favored in various housing types, including those in Western settings.



Fig.202



Fig.203

Opposite page, top to bottom, Fig.200 Shoji screens in a contemporary Japanese house. / Fig.201 Torn shoji screens repaired with colorful fabric. / Top to bottom, Fig.202 A sudare (center) filters the light before it reaches the shoji screens. / Fig.203 Tate-shoji, or upright shoji screen used in a modern house.



Fig.204



Fig.205



Fig.206

Maison Bordeaux, France

OMA (Rem Koolhaas), Inside Outside

1994-1998, 2011-2012

Indian Douppion silk and Habutai silk (guesthouse and caretaker's house); Antung-Honan silk (bathroom and master bedroom); PVC (balcony); high-gloss film (PVC), clear glass film (PVC), faux leather (PVC), black-out fabric (PC, PL, CO) (children's bedrooms); cotton + clear glass film (living room); synthetic mesh (polyethylene) (outdoor terrace)

2. Curtain walls to textile curtains

Since Shigeru Ban created the Curtain Wall House in 1995, architects and designers have been intrigued with the idea of “the emancipation of the curtain wall.” When static walls are replaced with lightweight fabrics, buildings can be transformed into a moving, expressive form of architecture, often becoming more inviting and dynamic. Like the Japanese screens described above, these “real” curtain walls – with the correct selection of material – can effectively screen off intense light by still allowing enough ventilation.

Inside Outside conveys a direct execution of this emancipation through the re-visitation of Maison Bordeaux. The villa designed by architect Rem Koolhaas was originally built in 1998, renowned for its “exaggerated use of technology,” where a central room would travel up and down the different floors (Maak 2013) (fig. 204). This moving floor was designed to adapt to the needs of a wheelchair user. Petra Blaisse of Inside Outside reinterpreted the three-stacked layers of the building and introduced curtains that suited each floor. For example, the middle floor, which is most transparent due to the large glass façade, is further enhanced by the lightweight grey net around the terrace (fig. 205). Its way of freeing the architecture of absolute solidity corresponds to the overall concept of the building. Furthermore, the “semi-transparent” top floor is accompanied by shimmering silver curtains that reflect the landscape; the curtains are opaque but they show a vague depth that looks “semi-transparent” (fig. 206). Of course, they sufficiently reflect the sunlight

and keep the interior cool.

Similarly, Sylvie Krüger designed exterior curtains for sun protection in a lake house (fig. 207). Here, the wooden panels of the second floor can also be opened and closed like a curtain. A house in Austria by Maria Flöckner and Hermann Schnöll has UV-proof PE raschel curtains on three sides of the building, which can either float or be fixed at the bottom rim as well (fig. 208, next page). Where the roof extends further than the glass walls, vague spaces between inside and outside emerge, covered only by fabric (fig. 209). Furthermore, a social housing project by Lacaton & Vassal consists of transparent polycarbonate facades, eliminating the sense of closed spaces with similar constructions of a greenhouse (fig. 210). Curtains and canopies define the spaces of the otherwise transparent building; therefore it is difficult to define what divides the spaces into inside and outside.

Ordinary curtains, however, are generally more vulnerable to outdoor climates than glass walls and may easily become unclean with dirt and insects. In turn, the application of lightweight technical textiles as curtains would be a durable solution, also improving the light controlling and insulation properties.

Details of mentioned works, in order of:

- **Name of building or project**, Place
- Architect or interior designer (if applicable), Textile designer or designer (if applicable)
- Year
- Materials, techniques (if known)

Lake House, near Munich, Germany
Muck Petzet Architekten, Sylvie Krüger
2011



Fig.207



Fig.209

House 47°40'48''n/13°8'12''e, Adnet, Austria
Maria Flöckner and Hermann Schnöll
2005-2007
UV-proof PE raschel fabric

Social housing, Mulhouse, France
Lacaton & Vassal
2005



Fig.210





Fig.208

House 47°40'48"n/13°8'12"e, Adnet, Austria
Maria Flöckner and Hermann Schnöll
2005-2007
UV-proof PE raschel fabric

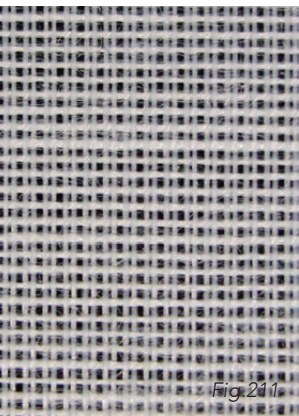


Fig.211



Fig.212



Fig.213

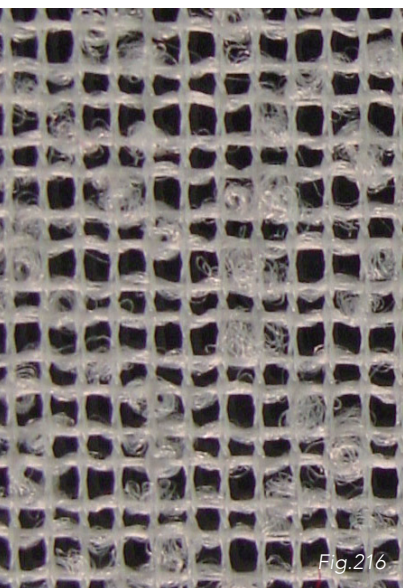


Fig.216



Fig.217

3. Semi-transparencies

When intense sun-screening is not a high priority, lighter textiles which are transparent and translucent can be used to block out the harshest rays. These sheer fabrics can provide sufficient daytime privacy as well. Although semi-transparencies do not have superb acoustic properties and are see-through at night, architects and designers favor them because they often do not obscure the character of the architecture and maintain a certain level of function.

There are several types of traditional lightweight curtains. *Ninon* is a plain woven fabric, where “every third warp yarn has been omitted” to create larger spaces, increasing the translucency of the fabric (Yeager and Teter-Justice 2000, p.281) (fig. 211). *Organdy* or *organdie* has a stiffer, parchment-like hand, and is produced by exposing an all-cotton fabric to a weak acid (fig. 212). Organdy is also made of polyester or monofilament nylon (ibid., Kadolph 2009, p.62). *Voile* is made with highly twisted yarns of cotton or a blend of cotton and polyester fibers, and it is slightly less transparent (fig. 213) (ibid., ibid.). In *dimity*, larger warps or grouped yarns form ribs, and it is similar to the openness of organdy and voile (Yeager and Teter-Justice 2000, p.282, Kadolph 2009, p.65) (fig. 214). The *leno weave* has larger openings due to crossed warp yarns locking the wefts, also softening strong light (fig. 215). *Marquisette* is a transparent leno-woven fabric (Yeager and Teter-Justice 2000, p.286) (fig. 216). *Mosquito netting* is also transparent but has a more compact structure (fig. 217).

Semi-transparencies produce delicate effects and, when combined with glass, create vague and airy boundaries. One example is seen in the Glass Pavilion in Toledo, Ohio by the architecture firm SANAA of Japan. Here, Inside Outside designed curtains that would “leave the transparency and sobriety of the architecture intact” (Blaisse 2007, p.409) (fig. 218, next page). After numerous trials, they proposed very thin curtains with small detailing. The track configurations were designed so that the curtains could be layered and pleated to achieve different levels of shading (ibid.). An air gap of transparent material is added to the top and bottom rim, further emphasizing the “lightness” of the architecture (fig. 219).

The SteelHouse of agps architecture ltd. also utilizes translucent screens, but on the outside of the building (fig. 220, fig. 221). MoyaMoya by Fumihiko Sano of studio PHENOMENON has a double-layered

Top, left to right, Fig.211 Detail of ninon weave, made of polyester. / Fig.212 Organdy fabric in various colors. / Fig.213 Voile curtain. / Fig.214 Dimity, made of cotton. / Fig.215 Leno weave with waxed cotton. / Above, top to bottom, Fig.216 Marquisette made with polyester. / Fig.217 Mosquito netting, detail.

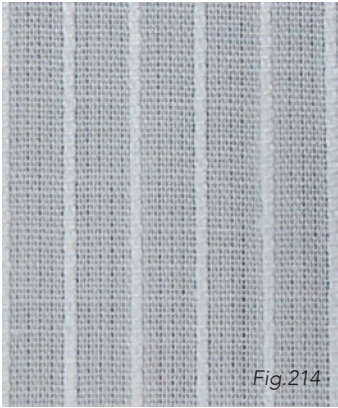


Fig.214

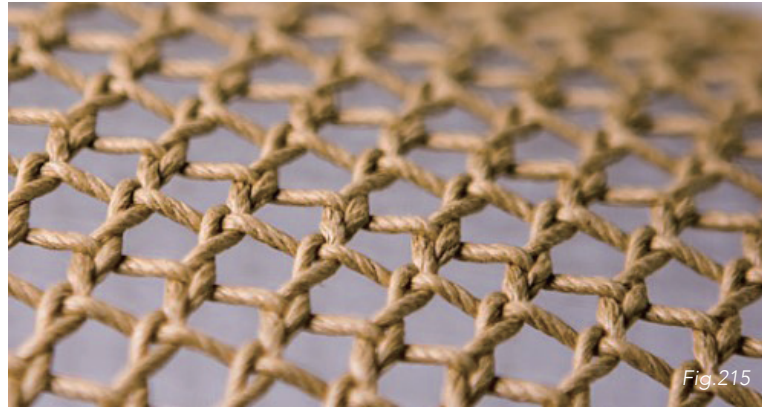


Fig.215

Glass Pavilion, Toledo, Ohio, USA
 SANAA, Inside Outside
 2002-2006
 Verosol 810,000 FR (Polyester weave) with
 aluminum powder coating
 Grey front, silver back. 15% pleat.

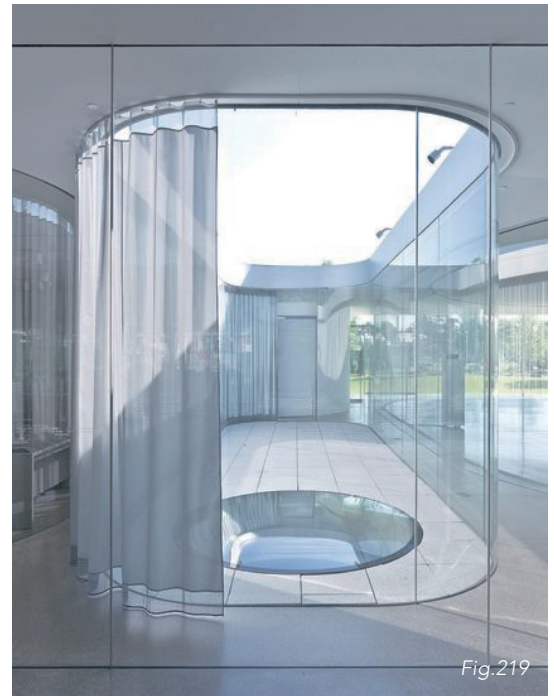


Fig.219

SteelHouse, Nichols Canyon, USA
 agps architecture ltd.
 2008-2011



Fig.220

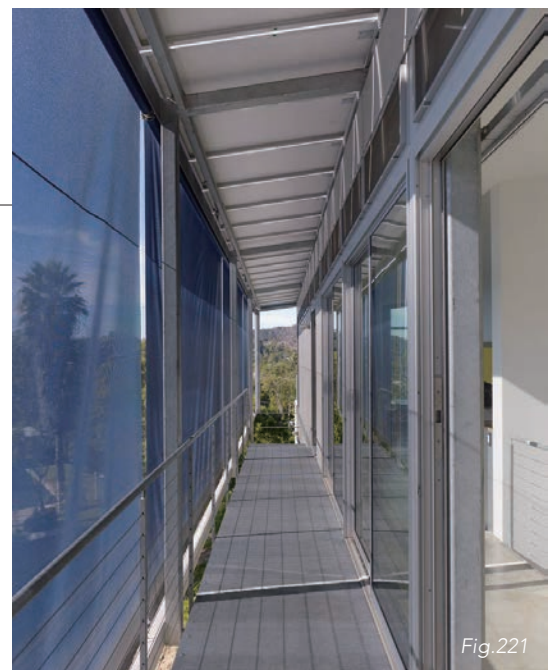
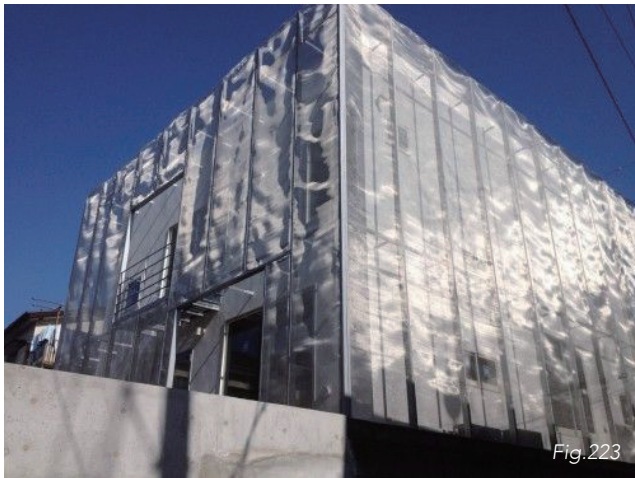


Fig.221



Fig.218

Glass Pavilion, Toledo, Ohio
SANAA, Inside Outside
2002-2006
Verosol 810,000 FR (Polyester weave) with
aluminum powder coating
Grey front, silver back. 15% pleat.



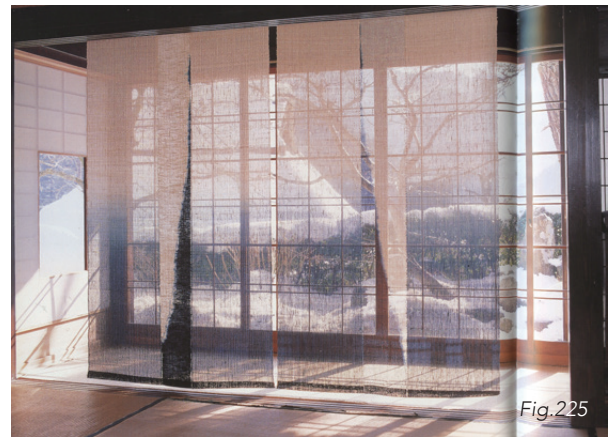
MoyaMoya, Tokyo, Japan
Fumihiko Sano (studio PHENOMENON)
2014
Stainless steel mesh

stainless steel fence surrounding the building that diffuses the light (fig. 222). Like textiles, it creates moiré patterns that change the appearance of the architecture at different times of the day (fig. 223). All of these interventions softly diffuse sunlight while adding a minimal but intriguing layer to the building facades.

Textile artists and designers also experiment with light and transparency in architectural spaces. Akane Moriama's works are often translucent and their soft colors blend together with the opposite view (fig. 224). In Hiroyuki Shindo's indigo dyed works, subtle gradients melt together with the landscape and traditional Japanese architecture (fig. 225). Outi Martikainen's Cathedral also displays a similar transparency, but it is made of insect net (fig. 226). These works do not specifically act as sun-screening fabrics, but can become sources of inspiration for more functional textiles, which are now often monochromatic and plain.



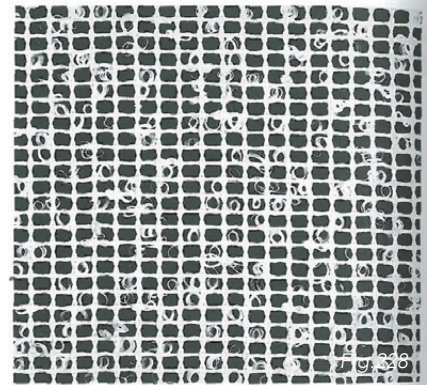
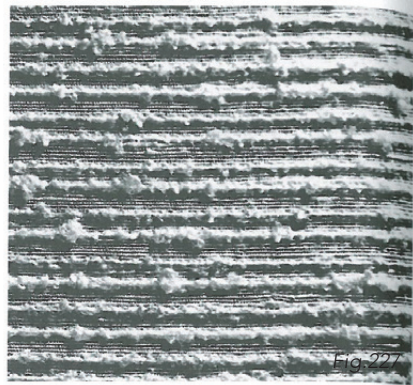
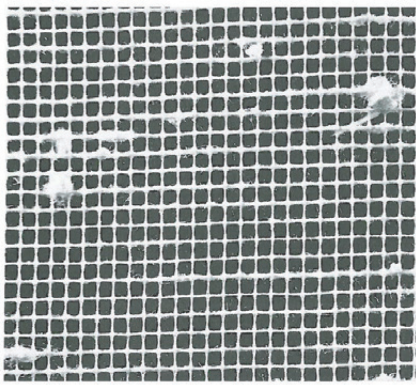
radiant flux installation, Stockholm, Sweden
Akane Moriama
2014
Silk organzie



Indigo dyed silk screens
Hiroyuki Shindo
Silk



Cathedral
Outi Martikainen
2008
Insect net, nylon



4. Various structures and “openness”

As discussed earlier, different openness of textiles can be designed in order to achieve different degrees of light transmission. Different structures in sheer fabrics create soft but lively shadows and are sometimes innovatively designed in relation to the building or surrounding elements.

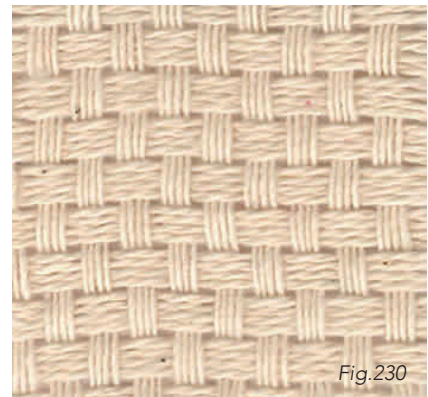
Textured yarns such as seed yarns and bouclé yarns can create uneven surfaces and alter its openness (fig. 227). Since glass fibers have high specific gravity, loop or curl yarns are often used to reduce openness instead of weaving a denser structure (Yeager and Teter-Justice 2000, p.252) (fig. 228).

The structures of woven fabrics also affect the openness of textiles. For example, the basket weave creates larger spaces in the fabric because two or more yarns are grouped and woven together, creating larger floats (fig. 229). Monk’s cloth, friar’s cloth, druid’s cloth, and mission cloth are all basket weaves that are used in window and wall coverings (Kadolph 2009, p.65) (fig. 230). The British company Salt designs textiles with focus on how light is transmitted through them and incorporates various woven structures that further enhance their textures (fig. 231).

Knitted fabrics are also used for window coverings. The gauge size and type of yarn directly affect their openness. As seen in Akane Moriyama’s knitted curtains, the edges naturally curl, adding a “soft and loose impression into space” (Moriyama, “knitted curtain, info”) (fig. 232). Furthermore, raschel stitching is a knitting technique that often is used to create lacy structures for curtains (fig. 233). Weft insertion is another method used to control the amount of openness in window coverings (fig. 234). Stitch-knitting holds yarns in a web structure, which can create freely designed openings in the fabric (fig. 235). At the same time, though, it is vulnerable to abrasion (Yeager and Teter-Justice 2000, p.292-293).

Lace and net fabrics are often used to soften the most intense rays of daylight. These textiles are created with a knotting and twisting operation. Highly ornamental lace fabrics often sag easily, but this can be improved by using thermoplastic fibers that are properly heat set (ibid., p.293).

Textiles with airy constructions can also be created directly from fibers as non-woven textiles. For example, manufacturers can easily manipulate the positioning of the fibers in spunlaced fabrics, which are often used as disposable fabrics in care-type facilities (ibid.). Another benefit of these



Above, from top left to right, Fig.227 Marquisette with seed yarns (left) and drapery fabric with bouclé yarns (right). / Fig.228 Leno-woven casement composed of loop yarns in glass fiber. / Fig.229 Basket weave in polyester. / Fig.230 Monk's cloth. / Opposite page, left, from top, Fig.231 Alternate Longitude, product of Salt, 2009. / Fig.232 / Far right, from top, Fig.233 Raschel-stitched casement fabric. / Fig.234 Casement fabric produced by weft insertion. / Fig.235 Stitch-knitted casement fabrics.



Fig.231



Fig.232

knitted curtain, Osaka, Japan
 Akane Moriyama
 2010
 Linen

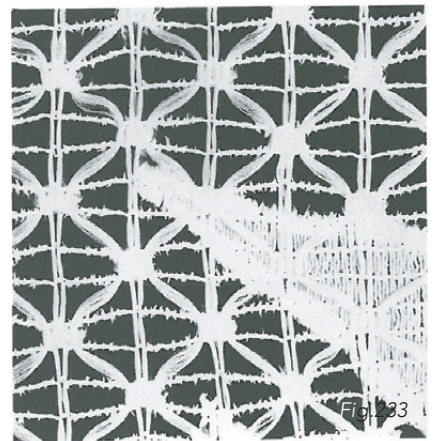


Fig.233

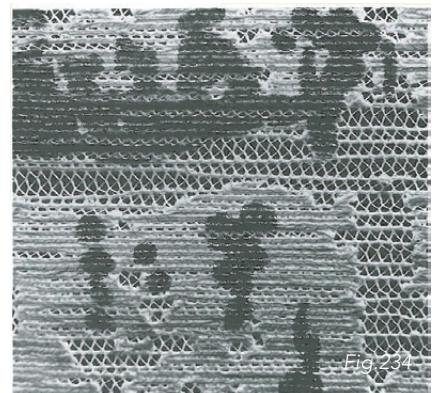


Fig.234

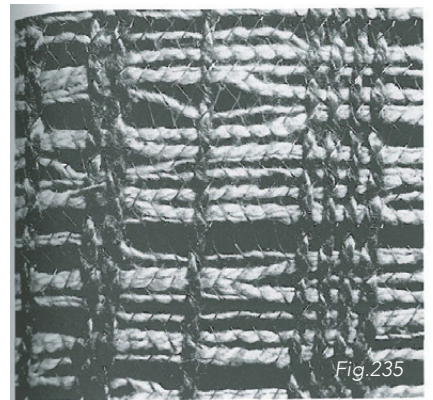
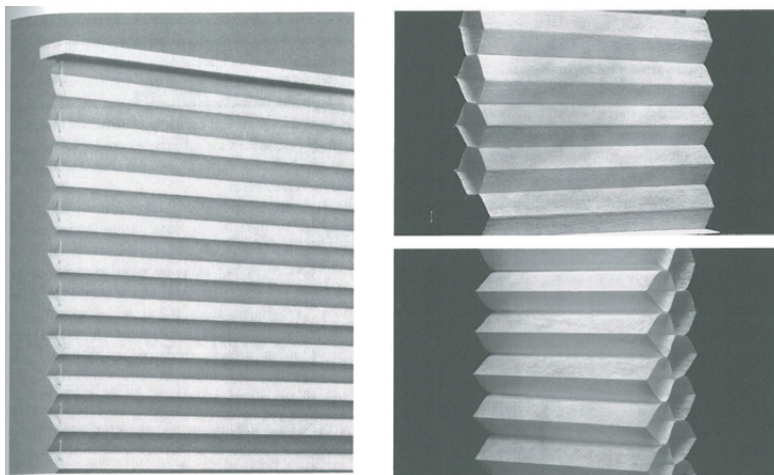


Fig.235



Left, Fig.236 Accordion-pleated shade. / Right,
Fig.237 Honeycomb cellular shades with single
(above) and double-cell structures.

Tama Art University Library, Tokyo, Japan
Toyo Ito, Yoko Ando (NUNO)
2007
made with cut-jacquard technique



Fig.238



Fig. 239

Louis Vuitton Omotesando, Tokyo, Japan
Jun Aoki, Yoko Ando
2002
Thin textiles with tape



Fig. 240

Cornell University, New York, USA
OMA, Inside Outside
2007-2012

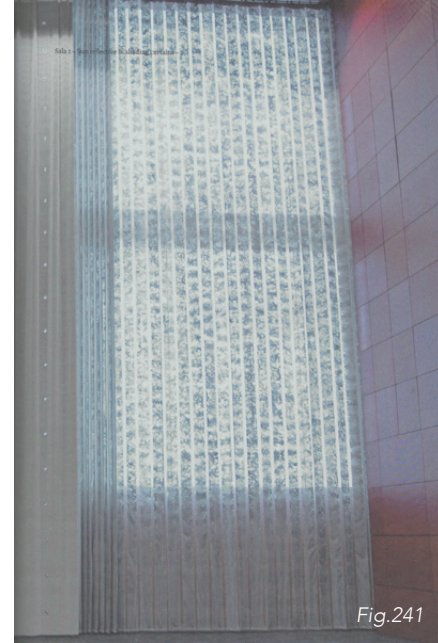


Fig. 241

Casa da Música, Porto, Portugal
OMA, Inside Outside
1999-2005
Laser scrim (towards the foyer); white choucroute (Contra-H) (in-between); white voile sealing (towards the auditorium), 10% pleat

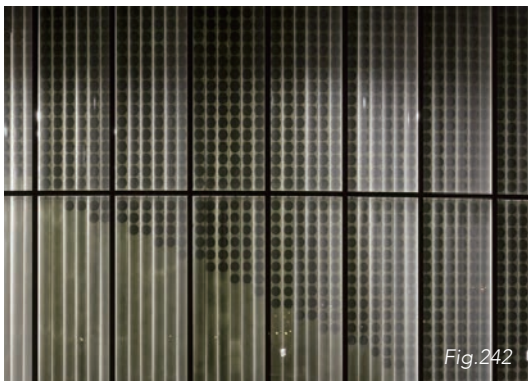


Fig. 242

Birkerød Sports and Leisure Centre, Denmark
SHL Architects, Astrid Krogh Design
2007
Fibreglass lamellas

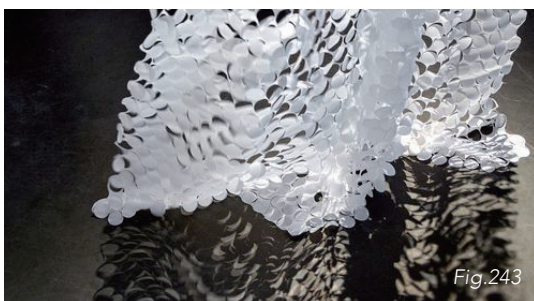


Fig. 243

A.H.I.T., A Hole in Textile
Camilla Diedrich
laser-cut

stitch-bonding and spunlacing techniques is that they are less expensive because they skip the yarn spinning process.

Moreover, light controlling textiles do not necessarily have to be flat. Pleated and cellular shades with three-dimensional structures are made with textiles with various opacity levels and textures. Accordion-pleated shades are made with stiffened textiles that are woven or knitted (fig. 236). Since the folds gather dust, metallic coatings are sometimes applied for static reduction as well as for insulation purposes (Yeager and Teter-Justice 2000, p.273). Cellular shades, or honeycomb shades, have a single or double cell structure, reducing the amount of heat transfer (fig. 237). Different materials and colors can be used in each layer to achieve the highest performance. There are also cellular shades with disconnected cells. They flatten like blinds when light is necessary, and when closed retain its insulative cellular structure.

A new and emerging field of experimental structures that combine various techniques and materials are introducing a new arrange of openness into textiles. For example, Yoko Ando designs textiles inspired directly from the architecture, such as the curtains reflecting the arches in the Tama Art University library, and the “L” and “V” patterned curtains for Louis Vuitton Omotesando (fig. 238, fig. 239). Petra Blaisse’s curtains also often have various structural patterns that affect the way light shines through (fig. 240, fig. 241). The large-scale blinds by Astrid Krogh Design for the Birkerød Sports and Leisure Centre are made of fiberglass lamellas with a pattern of black circles (fig. 242). New technologies like laser-cutting result in the innovative textiles of Camilla Diedrich (fig. 243). These innovative textile structures push the limits of textiles that are still considered weak among other materials. Overall, radical approaches with sufficient durability consideration are a must for the future of textiles.



Fig.244

Kindergarten Susi Weigel, Bludenz, Austria
Bernardo Bader
2013



Fig.245

Zollverein School of Management and Design, Essen, Germany
SANAA
2005-2006



Fig.246

Hair Salon of Ogikubo, Tokyo, Japan
Norihsa Kawashima, NUNO
2013
Custom crystal pleats

5. Creative ways of placement

Although sun-screening textiles are naturally only necessary where the windows are, some designers have left this idea behind to install curtains in various amounts and positions. In fact, curtains that cover walls from the edge of the ceiling down to the floor, meaning larger than the windows, are more common now in both residential and public buildings (fig. 244). In this style, window frames and curtain railings are of minimal visual influence. Curtains are related to the entire wall more than an individual window and are therefore less of an interior decoration. One example is the Zollverein School of Management and Design by SANAA, where walls with square windows – placed in order to capture the maximum amount of daylight – are entirely covered by curtains (fig. 245). According to the various directions of sunlight, the lit squares and the surrounding shadows move along the large fabric.

Sometimes a fabric covers other surfaces than the wall, like the hair salon of Ogikubo in Japan (fig. 246). Here, the curved drape on the ceiling and connected curtains together create an integrated soft atmosphere.

Furthermore, sun-screening textiles can be entirely liberated, even from a wall. In the Rosenhügel project of Berger + Parkkinen Architects, curtains can be moved around freely to incorporate the balcony into either the interior or the exterior (Parkkinen 2015) (fig. 247). Tiina Parkkinen explains that “many housing projects are very dense,” and she enables the inhabitants to alter the amount of privacy at their own will (2015).

Another approach is to manipulate the direction and attachment methods of textiles. Along the windows of the Sasso restaurant in Helsinki, Carola Rytsölä twisted and attached textile strips that were unevenly painted with gold paint (fig. 248). Like this example, many spatial textiles are not complete before the actual installation process, and careful considerations on site are vital.



Fig.247

Rosenhügel, Vienna, Austria
Berger + Parkkinen Architects
2014-2016
Lightweight fabric used for flags



Fig.248

Restaurant Sasso, Helsinki, Finland
Carola Rytsölä
(before 2007)



Fig.249 Street toldos of Seville, Spain.

6. Usage in exteriors

Textiles have long been used as exterior awnings in warm climates. In warm and dry countries such as Spain, normal fabrics are placed outside the windows, often creating colorful scenery. “Street toldos,” seen in southern Spanish cities, are still used across streets to protect pedestrians from direct sunlight. Similar forms are found throughout the Mediterranean area, in countries such as Morocco, Egypt, Syria, and Turkey, and also in South America and Japan (fig. 249) (Krüger 2009, p.92).

On the other hand, with the development of more durable technical textiles, sunlight is efficiently regulated with large-scale exterior treatments. When used in exteriors, textiles can define the entire look of the architecture. The façade of the renovation project of the King Fahad National Library illustrates Arabic patterns using membrane fabrics (fig. 250). The Sedus Stoll AG building uses simpler rectangular fabrics, but they still characterize the rhythm of the façade (fig. 251). Atelier Amont’s Summer Pavilion also uses plain fabrics, but the bright layers define the pavilion itself (fig. 252, next page). The Wall House by FAR is constructed of four layers, each with their own “climatic, atmospheric, structural, material, and functional properties” (FAR FROHN&ROJAS, “Wall House”) (fig. 253). The most exterior layer is an envelope made of aluminum bands woven with polymer threads, and different weave densities are utilized to achieve various sun-screening degrees according to the orientation (Krüger 2009, p.188). The textile can reflect between fifty and seventy-five percent of the sunlight (ibid.).

In contrast to the static exterior textiles of the above,



King Fahad National Library, Riyadh, Saudi Arabia
Gerber Architects
2007-2014
Filigree textile façade with steel wire construction



Sedus Stoll AG, Waldshut-Tiengen, Germany
Ludloff + Ludloff Architects, Structural
engineering by Werner Sobek
2007-2010

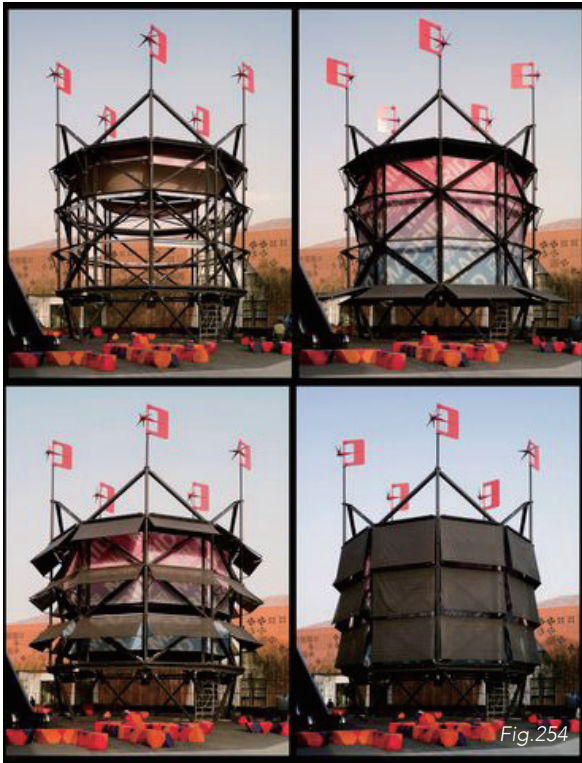


Wall House, Santiago, Chile
FAR FROHN & ROJAS
2004-2007
Energy screen made of aluminum bands woven
with polymer threads and insect fabric



Fig.252

Summer Pavilion, Hasselt-Genk, Limburg, Belgium
Atelier Amont
2014



"Air Tree," Madrid Pavilion, EXPO Shanghai, China
Ecosistema Urbano
2010
Serge Ferrari screens Soltis 86 and 92 fabric

there are also movable and adjustable sun-screening facades. The "Air Tree" of the Shanghai Expo is made of technical textiles that tilt according to the changing light intensity (fig. 254). At night, a hidden layer with insulating properties appears, enveloping the building. Integra H2/4 by agps architecture ltd. has exterior screens that cover the entire façade when closed (fig. 255). Their Wohnhäuser Hohenbühlstrasse also presents similar qualities, but with lustrous metallic curtains (fig. 256).

Moreover, Kennedy & Violich Architecture experiments with new concepts in spatial textiles. In the Soft House research, they propose curtains that harvest energy and emit light (fig. 257). The curtains can follow the sun to generate up to 16,000 watt-hours of electricity, and its density can be customized with a design software to accommodate certain needs. Although not realized yet, this research proves that textiles could one day replace the unsightly solar panels of today.

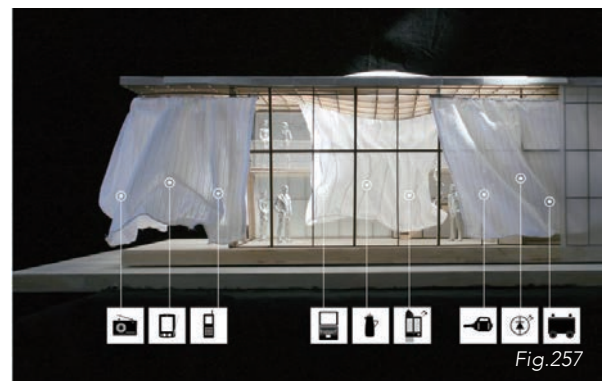
More details about textile materials for exteriors are explained in Chapter 3.1.5.



Integra H2/4, Wallisellen, Switzerland
agps architecture ltd.
2006-2009



Wohnhäuser Hohenbühlstrasse, Zurich, Switzerland
agps architecture ltd.
2001-2004
Metal curtains



Soft House, USA
Kennedy & Violich Architecture, Intelligent textiles
engineerings by Interactive-Wear GmbH
2008- ongoing
Energy harvesting and light emitting textiles



Fig.258

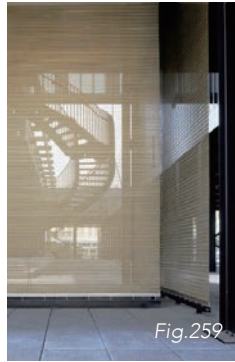


Fig.259

Court of Justice of the European Communities, Luxembourg
Dominique Perrault Architecture
2008
Anodized gold-tinted aluminum mesh

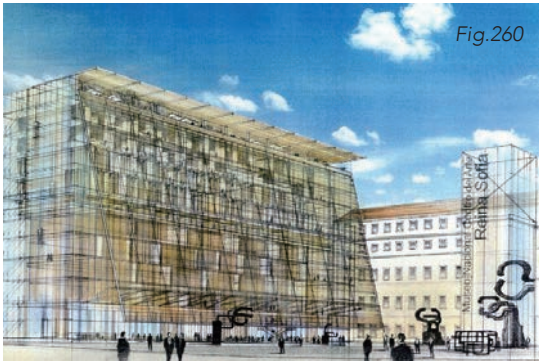


Fig.260

Extensions to Queen Sofia Art Centre (Proposal), Madrid, Spain
Dominique Perrault Architecture
1999
Gold-tinted metallic mesh



Fig.262

Ferreteria O'Higgins, Santiago, Chile
GH+A Guillermo Hevia
2011
Corten steel

7. Non-textiles

In order to regulate sunlight in new and unique ways, architects often use materials that are not but structured like textiles. Steel mesh is a popular material used in this way, with its famed user being architect Dominique Perrault. In the Court of Justice of the European Communities, the same golden aluminum mesh is used in both interior and exterior (fig. 258, fig. 259). In his unrealized proposals, Perrault demonstrates a more flexible and large-scale application of meshes, which envelop entire buildings (fig. 260). SANAA's winning proposal for the Taichung City Cultural Center is also covered by a transparent curving mesh (fig. 261).

Perforated Corten steel louvers resemble textile sheets on the Ferreteria O'Higgins office (fig. 262). Besides steel, wooden elements have been structured like woven fabrics to screen off sunlight, also producing interesting shadow patterns. In the Islamic Cemetery designed by Bernardo Bader, a steel mesh curtain supports wooden shingles that create an animated pattern (fig. 263). The wooden ceiling of the Sunpu Church in Japan diffuses light through its striped structure (fig. 264). The Rokkou Shidare observation deck consists of a wooden dome that simulates light passing through foliage, as the name "Shidare" (枝垂れ the weeping of a tree) suggests (fig. 265). Elisa Stroyk, known for her wooden tessellated "textiles," designed a similar handmade curtain in collaboration with OMA (fig. 266). Being natural materials, both textiles and wood bring warmth to bare interiors.

These alternative materials are more rigid and can generally stand outdoor climates longer than textiles. However, they can be too stiff at times, amplifying unwanted sound, and consequently an additional textile layer may be necessary.



Fig.263

Islamic Cemetery, Altach, Austria
Bernardo Bader
2012
Wood shingles and steel mesh



Taichung City Cultural Center (Winning Proposal), China
SANAA
2013-
Mesh



Fig.264

Sunpu Church, Shizuoka, Japan
Taira Nishizawa
2008
Wood

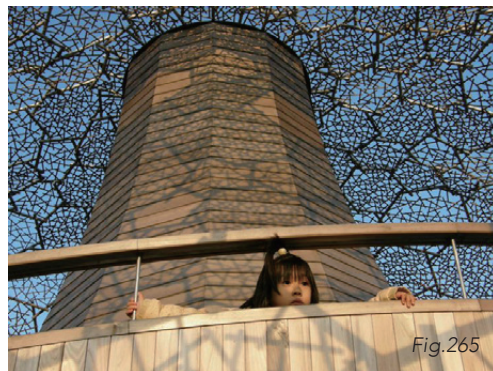


Fig.265

Rokkou Shidare, Kobe, Japan
Hiroshi Sanbuichi
2010
Hinoki (Japanese Cypress)



Fig.266

**Wooden curtains for Maison Ullens
Flagship Store**, Paris, France
Elisa Strozzyk with OMA
2014
Wood



Fig.267



Fig.268



Fig.269

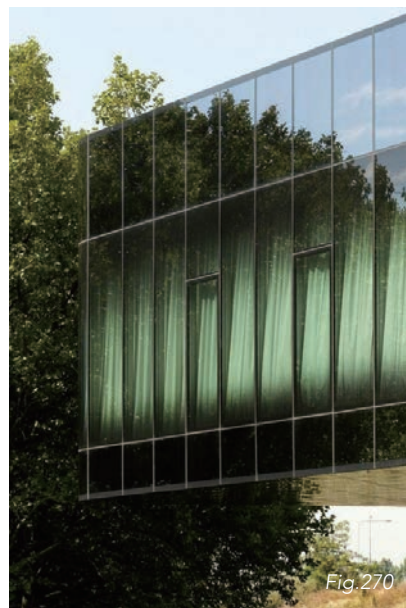


Fig.270

KONE Building, Espoo, Finland
Antti-Matti Siikala (SARC Architects), Outi Martikainen
2001
Silkscreen printed glass

Expo 2000 Finnish Pavilion, Hannover, Germany
Sarlotta Narjus and Antti-Matti Siikala (SARC Architects, Outi Martikainen
2000
Silkscreen printed glass

Far Left

Regiocentrale Zuid, Maasbracht, Netherlands
Wiel Arets Architects
2008-2014
Silkscreen printed glass

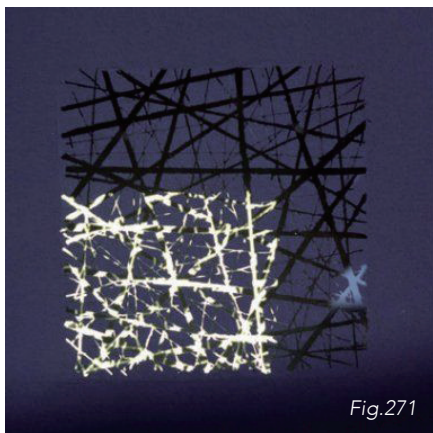


Fig.271

Glass work for entrance hall of Cultor office, Espoo, Finland
Kristiina Wiherheimo
1999
Painted and scratched glass

Glass itself is often manipulated to prevent strong sunrays from seeping into the interior. Glass can be sandblasted or perforated with pigment or films, according to the necessary degree of shading. Not only window manufacturers, but also textile designers undertake this surface design work. For the KONE building in Finland, Outi Martikainen designed the perforated look of the silkscreened glass (fig. 267). She designed three patterns of the four-meter long units so that the vertical lines would fluently connect (fig. 268). Since sandblasting is a costly method, a similar effect is achieved with a special silkscreen color, like in the façade of the Expo 2000 Finnish Pavilion, also designed by Martikainen (fig. 269). When silkscreened in black, like the Regiocentrale Zuid, the glass effectively reflects the surroundings and improves the interior privacy (fig. 270). Furthermore, works by Kristiina Wiherheimo prove that painted glass can be manipulated to look like actual textiles (fig. 271).



3.1.2 Temperature Insulation

Basics of Temperature Insulation

[WHAT]

The properties of textile material are suitable for insulating interior space. In winter, buildings require insulation to reduce heat loss. In summer, radiant energy should be efficiently reflected to reduce heat gain inside (Yeager and Teter-Justice 2000, p.254).

Heat is lost in various ways. When the air moves according to wind or another source, heat is transferred by convection. Faster movements and greater differences between inside and outside temperatures increase the amount lost (ibid.). Draughts, or cold air that seeps through small openings and joints, also contributes to this air movement. Heat is also lost is through conduction. This is “the movement of thermal energy through solids, liquids, and gases” (ibid.). Even though a wall separates the inside and outside, heat can be conducted through it. In residential buildings, windows alone may be responsible for the loss of 25 to 50 percent of the heat generated (ibid.).

According to expert interviews, temperature insulation is not a major consideration in Finland, as the double or triple layered windows already insulate sufficiently (Grönqvist 2014, Halminen 2015). However, in climates where winters are milder and summers require more ventilation, windows are not designed to solely keep out cold draughts. In order to reduce costs and resource usage in heating and cooling, insulative curtains become inevitable in these conditions. Before reinstalling an entire new set of windows, consumers can easily add another layer of textile in winter, and remove a layer in summer. Curtains that regulate temperatures will often simultaneously function as acoustic regulators. Acoustic control is further discussed in the next chapter.

Temperature insulation is also utilized in greenhouses. Here, plants and vegetables are grown in a controlled climate due to the building skin’s function of absorbing light and keeping the warm air inside. Greenhouses can be large and architectural in scale as well, like the Eden Project in Cornwall (fig. 272). This textile architecture was completed in 2001, and is made of ETFE (Ethylene-tetrafluoroethylene) foil-covered cushions on space frames (Drew 2008, p.33).

[HOW]

Normally, higher insulation values can be achieved with heavyweight fabrics compared to lighter ones. These include leather, tapestries, and velvets. However, heavyweight textiles are not commonly used, as architecture itself is becoming lighter; therefore, thick and rich textiles are not welcomed. Currently, insulation is often carried out in a more disguised way.

One way to increase the insulative properties of a textile is through a mechanical process called napping. This process raises the ends of the fibers to the surface, which can entrap more air inside (Yeager and Teter-Justice 2000, p.143). When napped on both sides, the fabric is termed flannel, and when napped on one side it is called flannelette.

Another way is to apply insulative finishes onto textiles. For example, a foamed acrylic compound is often sprayed or flowed onto the back of textiles (Yeager and Teter-Justice 2000, p.143). However, insulative finishes are likely to make the fabric heavier, less transparent and decrease its drapability (ibid., Nielson 2007, p.102).

Obviously, insulation efficiency is increased with precise installation of textiles and sealed edges. Instead of heavyweight textiles, an insulative layer between two fabrics can also function better than a single fabric.

Insulation materials are also applied to places other than windows. Lightweight boards, non-wovens, mats, foams and even loose material are applied to walls, ceilings, floors and roofs for both thermal and acoustic insulation

(Kozłowski, Kicińska-Jakubowska and Muzyczek 2009, p.30). When natural materials are preferred, natural fibers such as wool, flax and hemp are often used for these purposes (ibid.). Flax is especially valued for its excellent temperature-buffering characteristics, as well as its hollow structure that allows it to “breathe,” which is beneficial for the surrounding elements as well (ibid.). Non-woven insulation materials made of wool and flax have been developed to substitute glass fibre or mineral wool (ibid.). Hemp and polyolefin fibre based insulation materials are economical due to “an environmentally sensitive process (Canaflex)” (ibid.). Insulating panels made of expanded polystyrene, expanded polyurethane, cork, or plywood are also used (Yeager and Teter-Justice 2000, p.255). Vinyl wallcoverings are more durable than paint under normal conditions, and can last five times longer (Nielson 2007, p.172).

Examples, Details and Possibilities

Contemporary textiles used in architecture possess multiple functions, and sun-screening and sound absorbing textiles often simultaneously insulate air. In addition, as window efficiency has progressed in recent years, textiles that function solely to insulate air are rare. Therefore, new examples will not be discussed in this chapter. For related examples, refer to Chapter 3.1.1 and 3.1.3.

3.1.3 Acoustic Control

Basics of Acoustic Control

Acoustics of space refers to the sensation of the sound striking the ear.
- Renz van Luxemburg, 2005

Because it's always lack of acoustics...
- Tiina Rytönen, 2014

[WHAT]

In architectural space, one can hear three different kinds of sounds. *Airborne sounds* are emitted directly from the sound source, like talking voices and ringing phones. *Surface sounds* are radiated when objects are in contact and move along each other, for example when chairs are dragged along the floor. *Impact or structurally borne sounds* are produced from impacts when the surface vibrates, for instance when people walk or jump, knock on doors, or hammer nails (Yeager and Teter-Justice 2000, p.253). Some actions lead to the creation of multiple types of sounds, and sounds can even be heard far from their origin. According to Figure 273, sounds can easily be magnified with surface reflection (ibid., Courtesy of PPG Industries, Inc., 1978).

Not all sounds need to be regulated. Depending on the functions and situations of a space, sounds are termed as noise and become unnecessary, even irritating and disruptive. Many experts in textiles and interior architecture mention the importance of acoustic regulation, and Tiina Rytönen has noticed that it is “the challenge now all the time” (Rytönen 2014). She continues to explain that this is due to the increasing need of open spaces for offices to provide flexibility of divisions for different functions. The interior architect’s challenge is to simultaneously achieve this freedom and necessary acoustics. Furthermore, Rytönen states acoustics affect people’s emotions the most, alongside light. Renz van Luxemburg further proposes that “ideally, besides meeting with the particular use and function of the space, [curtains] should also ensure that the acoustic condition follows the light condition as it changes” (2005, p.220). Although sound is invisible to the human eye, we must never forget to consider it during the design process.

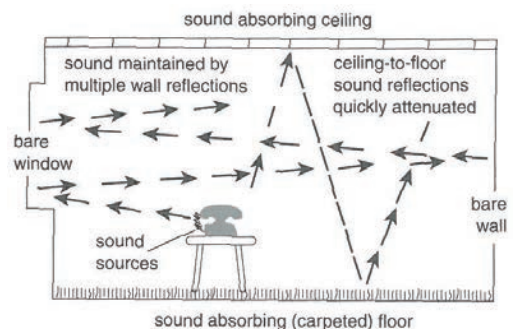


Fig. 273 Interior sound travel.

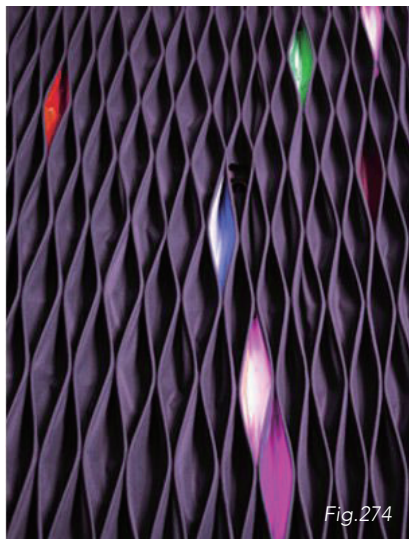


Fig.274

[HOW]

Hard and flat materials generally echo and amplify more sound, resulting in bright, lively acoustics. On the other hand, soft furnished spaces create a more muted atmosphere. The former effect is carefully considered in concert halls and theaters, where sound is intended to be delivered from one area to another. The latter effect is favored in both residential and commercial interiors, and textiles, which have various textural reliefs, are an optimal solution. Those who are hearing impaired do not welcome lively acoustics, since loud noises easily distract what they really want to hear (Nielson 2007, p.170).

Within the different materials of textiles, felt is especially valued for its excellent acoustic absorbency. True felt is made entirely or mostly out of wool, and the wool scales interlock to hold the fibers together into a mat or web. Being one of the earliest types of fabric, felt does not have long yarns and can be made directly from fibers (Kadolph 2009, p.83). Anne Kyyrö Quinn creates acoustic wall applications made from wool, manipulating its shapes to achieve various haptic structures (fig. 274).

Similarly to temperature insulation, foam backing is laminated to textiles to provide acoustic regulation. Textiles that are upholstered onto frames and attached to walls or ceilings also absorb sound. In this case, polyester and fiberglass are used as infill material, achieving a soft look. Plywood and mineral fiberboard are also used to regulate sound, and the former can also be tacked (Nielson 2007, p.169). Lightweight panels are said to absorb the low frequency sounds (Luxemburg 2005, p.220). Cork wallcovering has natural sound-absorbing qualities as well (Nielson 2007, p.170). In addition, when textiles are attached to a stable surface, they should absorb the least amount of moisture as possible, and satin weaves should be avoided to prevent rippling and sagging.

Moreover, acoustic controlling textiles do not only



Fig.275

exist on frames and panels. They can also be integrated into architecture through functional objects like furniture. In the Seinäjoki City Library of JKMM Architects, “the textile is somehow part of the interior architecture” (Rytkönen 2014) (fig. 275). Although the textiles lining the integrated seats are not free flowing, they are inevitably a spatial element, self-defining its sound absorbing function in the building space.

In general, three-dimensional weaves and fabric structures are more favorable in acoustic regulation, as they absorb sounds from various directions. For example, pile woven fabrics are three-dimensional, “made by interlacing an extra set of warp or weft yarns into the ground structure and creating short loops or cut ends on the surface” (Kadolph 2009, p.74). Examples of pile woven fabrics are velvet, velveteen, corduroy, and velour (fig. 276).

The porosity of textiles also affects its acoustic properties. Porous materials absorb the high frequencies (Luxemburg 2005, p.220). On the other hand, perforated panels absorb the middle high tones (ibid.). The relation between fabric openness and sound absorption quality is described in Figure 277. Therefore, even very thin materials can absorb up to sixty percent of acoustic waves – if the weaves are densely packed, or are technically regulated (Giuli and Ferrari 2013, p.11).

Even though the above ways can regulate sound in architectural space, designers still struggle with the acoustics in actual projects. For example, the interior design firm KOKO3 often uses thick spatial curtains to divide spaces in flexible ways. In the Supercell office, they designed a round meeting point in the otherwise empty space in the middle of a triangular room (fig. 278). Designer Jukka Halminen explains that they added the “partly functional, partly visual” spaces to easily add a brightening, “new layer which is more colorful than the building itself”



Fig.276

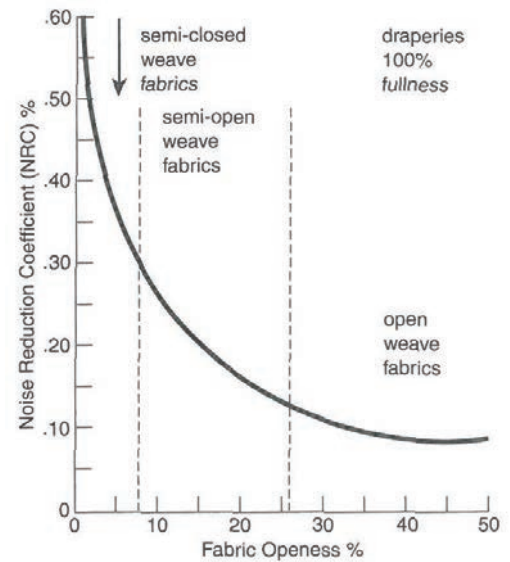


Fig.277



Fig.278

Opposite page, left to right, Fig.274 The Iceworks, Anne Kyyrö Quinn. / Fig.275 Integrated seats in the Seinäjoki City Library. / Top left to right, Fig.276 Velvet made of 80% polyester, 20% lycra. / Fig.277 Graph of noise reduction coefficient versus fabric openness factor.

(Halminen 2015). They can act as quick meeting points for short conversations. However, Halminen points out that they are not suitable for having longer meetings, because the space would need to be isolated more for the nearby people to work in peace. Whereas KOKO3 uses brightly single-colored textiles, interior architect Tiina Rytönen stresses the need of more interesting divider textiles that has less color and patterned prints, but more intriguing structures and surfaces. She wishes there would be more “architecturally” designed spatial textiles that are not “too busy and...are getting old so fast” (2014). As Rytönen has a background in textiles, I believe precise feedback like hers as an interior architect is crucial and very useful for future textile designers.

Seattle Central Library, USA

OMA, Inside Outside

2000-2004

(a) Heavy off-white Trevira CS, acoustically absorbent satin with a surface treatment (silkscreen print) composed of green vertical stripes (b) White flameproof plastic with a surface treatment (digital printing) depicting enlarged brown fur

Examples, Details and Possibilities

1. Flexible acoustic elements

Although intriguing acoustic textiles and partitions are still rare on the market, some architects and textile designers have succeeded in designing site-specific textiles that are both functional and uniquely placed.

Petra Blaisse has designed curtains that are multi-functional, in which both sides of the fabric are utilized. For the auditorium of the Seattle Central Library, Inside Outside proposed a curtain track that “loops around the stage and then aligns with one side wall; a kind of S-shape” (Blaisse 2007, p.204) (fig. 279). This track allows both sides of the curtain – “a heavy, pleated textile layer” to absorb sound and “a thick plastic lining” to reflect sound – to function according to the needs of the space it faces. Inside Outside’s curtains for the Lensvelt Furniture Headquarters in Breda glides along a U-shaped double track with a loop at the end (fig. 280). Either a warm, orange velvet or a three-dimensional silver surface will define the spatial atmosphere. Blaisse even explains that the curtain does not express the acoustic and darkening qualities it has, mainly emphasizing the atmosphere the textures create (Blaisse 2007, p.466).

As mentioned above, the Finnish firm KOKO3 designs spaces with flexible curtain elements. In the Kulttuurikeskus Korjaamo (Culture Centre Korjaamo), textiles divide the different spaces in a large building (fig. 281). For example, a balcony with textile walls floats on



Fig 279

one side, whereas hanging panels act as a “sound-eater” (Halminen 2015). Textile designer Sylvie Krüger has also designed sound-absorbing textile panels (fig. 282). With different material used on each side, the individual panels can be rotated to achieve different levels of privacy and acoustic insulation.

When small individual units compose a larger surface, an unlimited variety of spaces can be formed. This is the idea behind the “North Tiles” designed by Ronan & Erwan Bouroullec. For example, in the Kvadrat showroom in Stockholm, large textile tiles cover the walls and also become walls (fig. 283). The push-fit system allows new spaces to be created with ease.

Architects have had even wilder ideas with textiles in architectural space. In the J. S. Bach Concert Hall in Manchester, architect Zaha Hadid designed a curvaceous textile strip that wraps around the stage and audience. It simultaneously functions as an acoustic regulator and space divider (fig. 284).

These examples illustrate the diverse application methods of acoustic textile elements. Hopefully, the variation of sound regulating textiles increase in the near future, allowing designers to achieve precise effects with ease. Innovative textiles that are also applicable in “usual” environments with high requirements, such as offices, hospitals and libraries, need to be chiefly developed.



Fig.280

Lensvelt Furniture Headquarters, Breda, Netherlands
Wiel Arets Architects, Inside Outside
2000
Orange velvet and silver silk with holes with metal studs



Fig.281

Kulttuurikeskus Korjaamo, Helsinki, Finland
KOKO3
2005



Fig.291

Fig.282

Spatial partition, Germany
Sylvie Krüger
1999
Foam panels covered with white felt on one side and gray, PVC-coated fabric on the other



Fig.283

North Tiles, Showroom Kvadrat, Stockholm, Sweden
Ronan & Erwan Bouroullec
2006
Textile tiles with rigid foam core covered in two layers of material



Fig.284

J. S. Bach Concert Hall, Manchester Art Gallery, UK
Zaha Hadid
2009
Translucent fabric membrane with steel structure



Fig.285

BKV Group Office, Breda, Netherlands
Aleksandra Gaca

Architextile collection

Alexandra Gaca

2011

Cotton, wool, viscose, polyester and paper weft and cotton warp, various weave structures, Jacquard loom

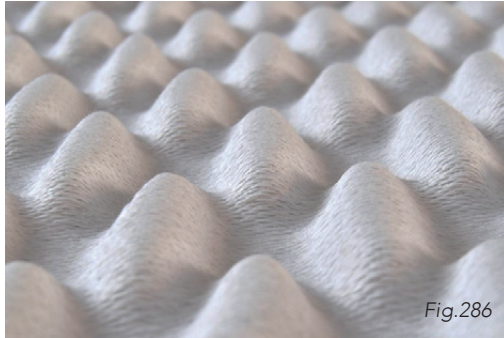


Fig.286

2. 3D woven structures

To achieve finer acoustic absorbance with less materials and fewer additional finishes, three-dimensional weave structures have recently been under much consideration. Not only are the weaves highly functional, they can also add haptic textures to plain environments.

Aleksandra Gaca designed various “Architextiles” for specific interiors, such as the BKV Group Office in Breda (fig. 285). Gaca integrates wool, mohair and metal threads to make various textile applications that can both complement and contrast with the building interiors. The three-dimensional example seen in Figure 286 is made of cotton, wool, viscose, polyester and paper weft, with a cotton warp on a Jacquard loom (Hemmings 2012, p.8).

Another Dutch designer working with woven structures is Samira Boon. She designed circular rooms of waffle weave walls with Trevira CS yarns (fig. 287). The highly three-dimensional structure increases the panel’s ability to absorb unwanted sounds. Boon continues to research with foldable structures that can also have prominent acoustic properties. My internship experience at Studio Samira Boon is further discussed in Chapter 5.

Although not a 3D woven structure in itself, an acoustic three-dimensional knitted wall was the initial concept for the Finnish Pavilion of the Shanghai Expo in 2010 (fig. 288). The scale was too large to use the knitting technique. Molded polyurethane was then considered, but it was still too heavy and the soft characteristics of textiles were lost. In the end, a blue knitted pattern was printed on to textile strips that were later woven together. Although the structure of the fabric itself did not affect the acoustics or the look, the design process still led to an innovative solution that is both practically manageable and visually pleasant. As producer, Päivi Grönqvist reflects: “it made the space more interesting than it would have been without it” (2014).

There is an infinite combination of structures and materials in textiles, and their effective matching can still be developed further. For example, architect Mikko Summanen mentioned the following (2014):

It would be great to be able to design a curtain system where you would have the lightness and the flexibility of real textile curtains, but you would at the same time be able to achieve [an] acoustical isolation, because this is in many cases...kind of destroying the whole idea...

By weaving durable but lightweight materials with sound absorbing structures, this can perhaps be achieved.



Fig.288

Blue Wall, Kirnu, Finnish Pavilion, Shanghai, China

Maikki Rytönen, Producer: Päivi Grönqvist (Vallila Interior)

2010

Digitally printed fabric strips



Fig.287

Rabobank Headquarters, Utrecht, Netherlands
NEXT Architects, Studio Samira Boon
2011
Trevira CS in waffle weave

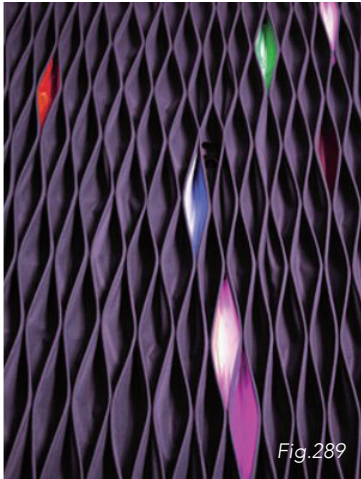


Fig.289

The Iceworks, London, United Kingdom
BDP Architects, Anne Kyyrö Quinn
Felt



Fig.290

3. Utilizing material properties (felt and metal)

Felt is a valued material by many textile artists and designers, intrigued by their capability of different shapes, colors and functional properties.

A leading designer in architectural applications of felt is Anne Kyyrö Quinn. She manipulates strips of felt in numerous shapes, also increasing its acoustic properties (fig. 289). Kathryn Walker of FELT also uses felt extensively to design entire atmospheres (fig. 290, fig. 291).

Textile artist Kristiina Wiherheimo designed a large pleated felt screen for the KONE building in Espoo, Finland (fig. 292). The blue felt covered an entire wall in the sixteenth floor of the office. Wiherheimo worked with felt in many other projects as well, such as *On the Snow* for a private house (fig. 293). Here, black yarn is sewn on the edges. When washed the black yarns hardly shrink while the felt shrinks to half its size, creating a haptic surface. Wiherheimo also mentions how felt is easy to attach in large scales with simple applications of Velcro.

Another textile artist is Claudy Jongstra who uses felt to create large wall applications to improve the acoustics. The wallcovering of the Fries Museum in the Netherlands is her interpretation of the Frisian landscape (fig. 294). Jongstra uses high quality wool felt that is produced from her own flock of sheep. There are many other felt artists that invent numerous ways of developing felt material.

A truly large-scale architectural application of felt is seen in the Sibelius Hall in Lahti, Finland (fig. 295). APRT architects consulted textile designer Päivi Grönqvist to design textiles with a primary function of acoustic regulation. The team worked together with Artec Consultants Inc. for advice on the acoustics. In the end, six pairs of roman blinds, each strip being nine by twenty meters, made of thick wool felt were applied outside the walls of the concert hall (fig. 296, 297, 298). Grönqvist states that the project started with “the function, but in the



Fig.291

Hotel One, Seattle, USA
Yabu Pushelburg studio, Kathryn Walker (FELT)
2007
Felt



Fig.294

Fries Museum, Netherlands
Bierman Henket Architects, Claudy Jongstra
2013
Raw silk, Drenthe heath sheep wool,
Wensleydale wool



Blue, KONE Building, Espoo, Finland
SARC Architects, Kristiina Wiherheimo
2001
Felt



On the Snow
Kristiina Wiherheimo
2001
Felt



Sibelius Hall, Lahti, Finland
APRT Architects, Päivi Grönqvist
2000
Wool felt





Fig.299



Fig.300

Faculty of Medicine, University of Oulu, Finland
 SARC Architects, Outi Martikainen
 2004
 Molded polyester felt



Fig.301

Path/Polku
 Outi Martikainen
 2006
 Molded polyester felt

end it's part of the architecture" (2014).

Felt can also be stiffened and thinned, improving the ease of application. Outi Martikainen used polyester felt that is molded from both sides and used in industrial applications for an acoustic wall in the University of Oulu (fig. 299). Martikainen arrived at this innovative solution, due to the fact that the architects wanted sound absorbing elements that had a soft look but could meet the strict requirements for large, public spaces. The heat molded tiles, each a box of 150 by 150 centimeters and ten centimeters deep, formed a pattern that illustrated an enlarged knitted textile (fig. 300). The hollow structure was optimal for reducing the echoes in the large hall. Martikainen also used the same material to produce artwork, where she needle-felted different colors from the back side before the felt was molded (fig. 301).

Besides felt, metal has been used as an acoustic divider. Sophie Mallebranche produced metal acoustic panels for a museum in Paris (fig. 302). Mallebranche's focus on metal yarns has led her to produce woven fabrics that are texturally and visually close to architectural elements (fig. 303).

Overall, materials with inherent acoustic properties are very useful, and it is up to the designers to manipulate them into elements that are appealing to architects and even more to the users of the architecture.



Fig.302

Events room, Museum of Hunting and Nature,
 Paris, France
 Sophie Mallebranche
 Metal

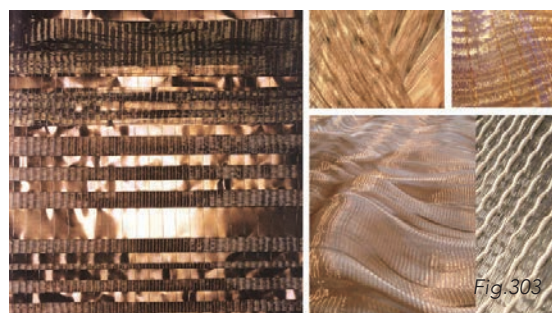


Fig.303

3.1.4 Visual Privacy and Temporary Division

Basics of Visual Privacy and Temporary Division

[WHAT]

Textiles are used as mobile elements and screens to manipulate the visibility in an architectural space. According to the selected material and structure, they can completely hide a scene, or allow delicate amounts of light to seep through, creating a diffused image of what is beyond.

The main function of curtains, other than screening off light is, of course, privacy. Privacy is becoming a pressing issue in urban settings, as growing cities accommodate more and more inhabitants, who inevitably live side by side. It is important to consider which views from outside need to be regulated, and also the differing lighting conditions, as they can completely alter the visibility through a textile. Normally, even light window coverings will reduce inward views during the daytime, but thicker or additional layers are necessary to ensure privacy at night (Yeager and Teter-Justice 2000, p.253). On the contrary, in some cases, an unsightly outside view may need to be manipulated with textiles.

In addition, textiles are frequently used to divide large, open spaces. There is a growing interest in creating flexible spaces that can transform themselves according to specific functions for different occasions. Partitions and changeable elements that allow people to “flex” are popular among clients, according to interior architect Jukka Halminen.

However, again, the problem still exists that flexibility does not easily go hand in hand with all the other necessary functions, such as lighting and acoustics. Interior architect Tiina Rytönen states that there is a wide variety of

upholstery fabrics, which liven up furniture, walls and floors in favorable ways. However, spatial dividers that are “multifunctional,” “acoustic and somehow see through and working nicely with light” are still not available (Rytönen 2014). She continues that they should also be “easy to take off, put [...] on and somehow light and temporary” and should not “take so much space.” Although this may seem like too many requirements for one piece of textile, it is exactly what both users and designers need: a multifunctional textile. Clients are eager to see spaces that transform according to their needs. At the same time, construction and implementation efficiency is a must in architecture now, and in the end, the impossible needs to be made possible. This is not easy, but by combining knowledge from different disciplines and integrating new technologies, steps need to be taken forward.

[HOW]

Traditionally, systems furniture was often used to divide office spaces. Walls were integrated with other furniture, and could be placed anywhere without any additional mechanism. Furniture companies collaborated with textile manufacturers to use textiles that have passed contract testing (Nielson 2007, p.168). However, “flexible” systems furniture is not considered flexible anymore. Actually, an infinite variety of materials are now used to divide architectural space. Therefore, the methods of achieving visual privacy and division will directly be discussed through the examples below.



From left to right, Fig.304 Fusuma screens of the Kachoden, the reception hall of Shoren-in (Shoren temple). / Fig.305 Byobu screen. / Fig.306 Tsuitate screen. / Fig.307 A simulated scene of old times, using a kicho in Shimogamo Shrine. / Fig.308 Kabeshiro, a white silk fabric, is hung.

Examples, Details and Possibilities

1. Traditional Japanese partitions

As mentioned in Chapter 2.9, flexible partitions are a prominent feature of Japanese architecture. In addition to the sun-screening panels discussed in Chapter 3.1.1, there are screens that purely function as spatial dividers.

Fusuma doors are the basic dividers in traditional Japanese architecture. They are made with either paper or fabric on a rectangular frame, and often have handles (fig. 304). When made with paper, various types of Japanese paper are layered on top of one another to achieve the necessary strength, also enhancing its acoustic and insulation properties. Whereas the lighter *shoji* screens let soft light through, fusuma screens absorb the light within its delicate fibers.

Fusuma doors need specific railing systems for it to be opened and closed, but other screens like the byobu, tsuitate and kicho can be placed freely. *Byobu* are flat-foldable screens consisting of multiple fusuma screens of smaller size (fig. 305). Like the fusuma, they are often embellished with landscapes and figures. Besides dividing spaces, they are used as backdrops for auspicious occasions. The *tsuitate* is similar to the byobu, but cannot be folded (fig. 306).

The above furnishings are mostly made of paper, but the kicho and kabeshiro are actual textiles. The *kicho* is a silk fabric that is hung from two T-shaped poles (fig. 307). It was used to attain privacy in interiors; for example, a woman of high rank hid behind the kicho so that the general public could not lay their eyes on her. On the other hand, the *kabeshiro* has a more specific design. It is made of white silk fabric and typically placed near the border of an interior space to substitute a wall (fig. 308).



Tsunagu: 'Connect', Milan Triennale, Italy
Kengo Kuma, Mitsui Fudosan Residential
2007
Bamboo

K and K Company, Tokyo, Japan
Isaku Design, NUNO
2013
Custom pattern flock print



Fig.310

Overall, Japanese partitions are designed to allow maximum flexibility in architecture. The fluidness is not overwhelming, however, due to the perpendicular lines and flat surfaces that dominate Japanese traditional architecture. The balance between emancipation and regulation is exceptional.

Naturally, Japanese partitions and architectural elements have continued to inspire contemporary architects in their designs. For example, architect Kengo Kuma reinterpreted the *sumushiko*, which is a screen made of thin, shredded bamboo sticks (fig. 309). Kuma used the modern *sumushiko* to surround and divide an entire prototype home, made for Milan Triennale. Although not made of textile material, the uneven shadows and delicate screening ability resemble a fabric made of natural material.

2. *Partitions with various materials and structures that alter visibility*

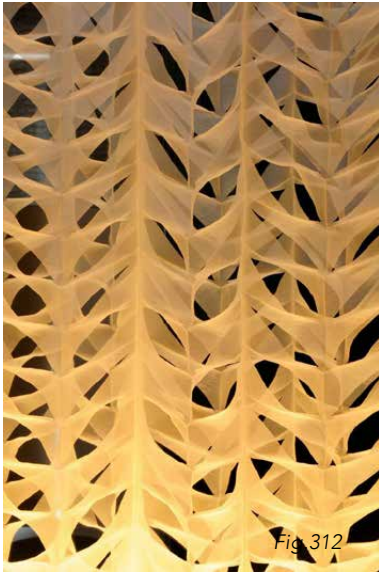
In order to achieve various degrees of transparency and privacy, textile designers utilize unique structures with different materials. This category was also explored in Chapter 3.1.1, when various levels of openness affected the amount of light that enters the interior. To divide spaces, however, there are less strict requirements for the fabric to withstand light and heat. Therefore, an even wider arrange of textiles can be seen in architecture.

Japanese company NUNO designs spatial textiles for specific buildings. Lead designer Reiko Sudo's creative approach has led to many fascinating collaborations, producing textiles that people have never seen before. For K and K Company, spatial textiles were placed in layers to softly diffuse light (fig. 310). The delicate differences in the pattern add additional depth to the air in between. NUNO often uses stitching to produce new textiles, like the partition seen in Oshale Messe (fig. 311). On the other hand, repetitive holes characterize the wall tapestries of the



Fig.311

Oshale Messe, Kanazawa Castle Park Ninomaru Square
Special Tent, Ishikawa, Japan
NUNO
2009
"Shutter"



MIXX Bar & Lounge, Tokyo, Japan
CURIOSITY, NUNO
2010
Custom origami pleats

Fig. 312

MIXX Bar & Lounge (fig. 312). All of the above spatial dividers are white, and are solely manipulated by using different techniques and structures. The users of the space are naturally lured to look at the details of the textiles, without simply determining its look from afar.

Besides traditional organic and synthetic textile materials, other materials are used to create partitions. For example, metal fabrics have been developed to be used in both residential and commercial settings. Metal fabrics consist mainly “of round, flat or stranded wires, or cables in stainless, titanium, chromium or chromium nickel steel” (Drew 2008, p.34). They are valued for their permanence and elegant luster. From quite a while ago, architects have used metal curtains, such as Rem Koolhaas with the Dutch House in 1993 (fig. 313). KriskaDECOR produces chain curtains that can be customized per link with various colors and patterns (fig. 314). The anodized aluminum chains can also be used outdoors, and weighs only three kilograms per square meter (fig. 315). American company Whiting & Davis produces Ring Mesh and Spider Mesh, which are metal curtains with various structures for residential purposes (fig. 316). Furthermore, traditional metal objects have now been redesigned in textile-like ways. Lace Fence transforms ubiquitous wire fences into intriguing patterns and surfaces (fig. 317). Still maintaining its original function, Lace Fence succeeds in adding diversity and charm to dull, everyday objects.

Although metal is a durable material for both interior and exterior use, its look does not always suit the favored atmosphere of a building. Perhaps a lighter, more natural feel is favorable for comfortable space. For example, although less resilient, the simple material of paper has attracted designers to create new products. The Canadian company MOLO creates foldable benches and freestanding spatial dividers made of paper (fig. 318). Although the surface is soft enough so as to allow bends and dents with a person merely sitting on it, the designers welcome the change as “a pleasing natural patina” (molo, “softseating”). The kraft paper is made fire-retardant. MOLO also produces textile versions of these dividers, made of a non-woven polyethylene material (fig. 319).

Materials are often the main concern of textiles in architectural space. There are strict restrictions such as flame retardancy and abrasion,

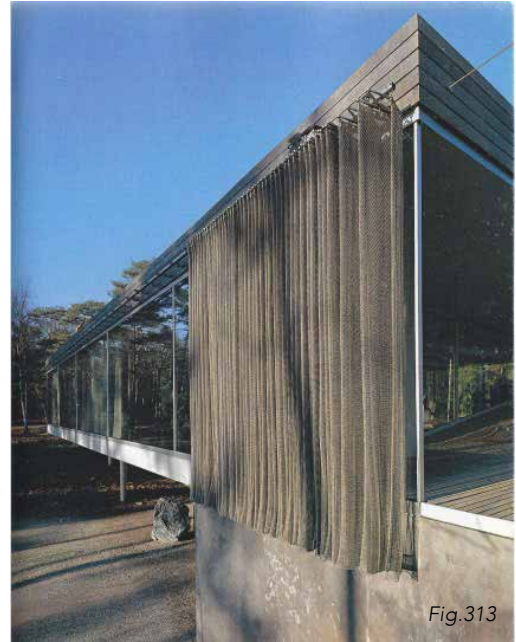


Fig.313

Dutch House, Netherlands
Rem Koolhaas, Dinxperlo Metaalgaasweverij
1995
Metal curtains



Fig.314

Arsenal Emirates Stadium, London, England
HOK Sport, KriskaDECOR
2006
Anodized aluminum chain curtains



Fig.315

Can Manent School, Barcelona, Spain
F&F Architecture, KritaDECOR
Anodized aluminum chain curtains



Fig.316



Fig.317



Fig.318



Fig.319

Small Stainless Steel Ring Mesh
Mary Bright (Whiting & Davis)
Metal curtains

Bended Lace Fence
Lace Fence
Galvanized or (white) PVC coated wire

softseating
MOLO
Kraft paper

softwall + softblock modular system LED lighting
MOLO
non-woven polyethylene material, LEDs

House in Waka-zaimokuza "Kuu no hako" (Empty box), Kamakura, Japan
Architect Cafe, Yoko Ando (NUNO)
2010



Fig.320

Österr. Botschaft in Zagreb, Croatia
Bernardo Bader
2013



Fig.321

limiting the use of innovative structures and materials. These restrictions can act as inspirations as well, as explored in Aoi Yoshizawa's Master's Thesis *Restrictions as Inspiration – An Exploration of the Design Process in the Contract Textile Industry*. However, it is still often the case that designers struggle to find attractive, tactile contract textiles that maintain the inherent softness and drapability of fabrics. Textile designer Maarit Salolainen recalls when she designed screen fabrics in collaboration with the Italian company Pugi. They aimed to achieve a natural fiber look, but the moisture was not sufficiently regulated in the room, so natural materials like wool would start to droop. In the end, they developed a new material out of polyester, mélange dyed, that had the visual effects of wool felt. Such cooperative material developments are crucial to produce contract textiles that will actually be favored and eagerly used in architecture.

Overall, various open structures and new materials are visually and texturally interesting, but hopefully durability will be a commonly valued trait in future textiles.

3. Uniquely positioned textiles

The diversity of textile shapes as spatial dividers is substantial – flat, curving, round, undulating – determining the shape of the space itself. In order to meet with the different needs of clients, curtain system companies now produce railings in different sizes and shapes. When applying spatial curtains in unique ways, not only the architect, but other experts such as electric engineers and plumbing professionals must collaborate to make it work (Rytkönen 2014). One cannot simply decide the position by him- or herself, as a building is a holistic system that must function normally and in emergency cases as well. When thought the other way around, however, carefully placed fire-resistant textiles could prevent fires from spreading.

With this in mind, the following examples propose more free, innovative ways of placing spatial textiles. A first group derives from the same idea explored in Chapter 3.1.1 of the emancipation of the wall. The Modern Movement brought forward architecture that could be freely divided with elements that do not bear any weight. Besides the frequent



Fig.322

Information Center Court, Rotterdam, Netherlands
Atelier Kempe Thill
2007-2008
Light-reflecting silver curtains



Fig.323

New Museum's Media Hub, New York, USA
Christoff Finio Architecture, Erik Bruce for Mary Bright Inc., Creation Baumann
"Malta" curtains (flame-retardant polyester (Trevira CS))



Fig.324

Extension to School Complex, Hirzenbach, Zurich, Switzerland
Boltshauser Architects
2005-2007



Fig.325



Fig.326

Danish Cultural Ministry, Copenhagen, Denmark
Louise Campbell and Marianne Britt Jørgensen
2005



Fig.327

Clouds
Ronan & Erwan Bouroullec produced by Kvadrat
2008
Flameproof polyethylene foam covered with wool or polyester



Fig.328

Sitra Office, Helsinki, Finland
KOKO3
2012

use of glass facades, static walls were also taken down, and fabrics were introduced in mid-space. Early examples of Mies van der Rohe are described in Chapter 2 (p. 56). Similar spatial textiles are seen in recent works, like “Kuu no hako” (Empty box) and architect Bernardo Bader’s works (fig. 320, fig. 321). In the Information Center Court of Rotterdam, the functions of the materials compensate each other; curtains achieve visual privacy, while the transparent glass box regulates the acoustics (fig. 322).

Additional aesthetic properties of color highlight the spatial dividers designed by Erik Bruce for Creation Baumann (fig. 323). The space-shaping curtains inside a school in Zurich reveal their bicolored stripes also towards the exterior, also functioning as sun protection curtains (fig. 324, fig. 325). In the Danish Cultural Ministry, colored frames with matching curtains outline the separate spaces of each of the staff (fig. 326). These designs illustrate how the sun-screening function can also be integrated into partitioning curtains.

Furthermore, there are even freer spatial textiles that do not require certain rails. Clouds by Ronan & Erwan Bouroullec produced by Kvadrat are textile tiles that can be assembled to create spatial surfaces of any size (fig. 327). Another customizable space is the completely flexible floor for the CEOs in the Helsinki Sitra office, designed by KOKO3 (fig. 328). The movable furniture and textiles directly relate to the concept of the space, which was to achieve more transparency and communication with the other workers (Halminen 2015). KOKO3 also installed a functional space divider that is felt on one side and whiteboard on the other.

There are also stationary spatial textiles, which cannot be opened or closed, but can better regulate light and



Fig.329

MiNO, Migliarino, Italy
Antonio Ravalli Architetti
2010
Translucent fabric



Fig.330

Elie Tahari Fashion Showroom,
New York, USA
Gisela Stromeyer Design
2011



Fig.331

Embassies of the Nordic Countries, Berlin, Germany
Berger + Parkkinen Architects
1996-2012
PTFE-coated glass fiber

sound. Tensioned fabrics are used for MiNO, a small room-in-a-room for a hostel (fig. 329). Each room is climatically independent, and can be easily reduced in number during the low seasons. Similar materials can also be used to loosely divide working spaces, like the fashion showroom in New York (fig. 330). In the Nordic Embassies in Berlin, a “light wall” separates a space both brightly and securely (fig. 331). The undulating shape brings in a relaxed feel to an otherwise formal setting. Of course, despite its free form, highly functional Teflon coated fabric is used to meet the strict requirements (Parkkinen 2015).

Textiles are also useful when creating temporal exhibitions and events. Sound is easily dispersed inside enormous pavilions and halls, and fabric partitions are optimal to create more intimate spaces (fig. 332, fig. 333). When temporary events take place outdoors, strong foils can isolate necessary space from varying weather conditions. The “Kitchen Monument” traveled around various cities in Europe and transformed unexpected spaces into lively rooms (fig. 334). Furthermore, temporality is inevitable in emergency situations. Light textiles can be easily transported to post-disaster sites to divide large shelters and to also become tents. Yoko Ando’s partitions for Fukushima were made in organza, aiming to soothe the residents with

their softness (fig. 335). After Hurricane Katrina, “The Pink Project” was initiated in New Orleans (fig. 336). This was an installation of 427 fabric elements, which were combined to resemble houses when enough donations were collected for reconstruction. The pink houses visualized the gradual process of recovery.

Overall, textiles could be applied in more innovative ways, not only to functionally divide a space, but also to revitalize an old or monotonous building. Even simple fabrics can have a surprising effect in architecture, depending on its unexpected way of placement. Furthermore, foldable and lightweight dividers that can be easily installed are likely to be more popular among clients and users. With these portable elements, architectural interiors will become more flexible and user-friendly. In addition, to avoid restlessness and chaos from the ever-changing space, quality materials should be carefully chosen.

“Küchenmonument” (Kitchen Monument), various
European cities
raumlaborberlin and Plastique Fantastique
2006-2007
Translucent fiber-reinforced PE foil

Right

Frieze Art Fair Tent, London, Great Britain
 Caruso St. John
 2008
 Wool

Fig.332



Fig.332

Presentation of Switzerland at the Frankfurt Book Fair, Frankfurt on Main, Germany
 Diener & Diener Architects
 1998

Cotton and felt, both made flame-resistant through impregnation, and chintz made of highly flame-resistant polyester fibers

Fig.333



Fig.335



Fig.333

"Partition Project," Fukushima, Japan
 Yoko Ando, Izumi Okayasu (producer)
 2011
 Organza

Fig.335

"The Pink Project – Make It Right,"
 New Orleans, USA
 Brad Pitt, Graft
 2007-2008

Fig.336



Fig.336



Fig.334

3.1.5 Weatherproof

Basics of Weatherproof

[WHAT]

Textiles are often regarded as vulnerable materials, especially in outdoor environments. Surely, textiles have certain characteristics, such as absorbency and moisture reactivity, which will not destroy it instantly, but will have negative effects in the long run. Good absorbency can be a positive trait, as soil and other unwanted particles could be easily released when cleaned with water. However, it would not be suitable for humid environments (Nielson 2007, p.37).

On the other hand, as technical textiles developed, their advanced properties allow them to be applied in many different climates and situations. In order to build larger structures with textiles, the developments in strong fibers and various finishes were progressive. These tough fabrics are now used in multiple applications, not only as temporary tents and domes, but also in long-lasting architecture. Textiles can now be immune to soil, water, sunlight, insects and wind. For outdoor use, strong materials such as acrylic, saran, and olefin are often used, and are generally solution dyed to maintain color fastness (Yeager and Teter-Justice 2000, p.275). More than ever, technical fibers represent a larger portion of the textile industry.

[HOW]

Traditionally, duck, or canvas, is coated with “vinyl solutions, rubber-based materials, or other synthesized compounds” to be used as a waterproof textile (Yeager and Teter-Justice 2000, p.282). Duck is often made with two-ply yarns, and woven with a basket or plain weave (ibid.) (fig. 337). Sailcloth is also made in a basket weave, and is lighter since only a single yarn is used. It is also used in interiors.

However, as described in the beginning of Chapter 3, there are newer technical textiles that have developed to fulfill higher requirements. The two most frequently used technical textiles, PVC-coated polyester and PTFE-coated fiberglass, have similar qualities, but the latter is much more expensive (Drew 2008, p.33) (fig. 338, fig. 339). It has superior weatherproof qualities and is advanced in “its durability (more than twenty-five years, rather than twelve or twenty years), long-term appearance,



Fig.337



Fig.338

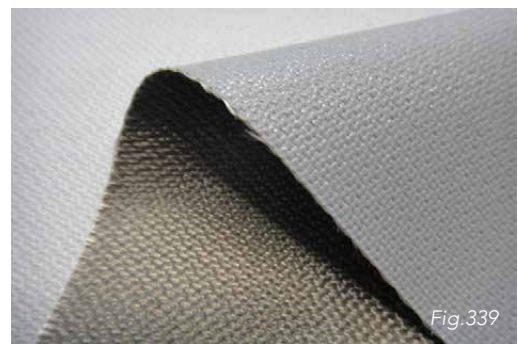


Fig.339

Opposite page, top to bottom, Fig.337 Heavy cotton canvas (duck canvas) fabric. / Fig.338 PVC-coated polyester fabric. / Fig.339 PTFE-coated fiberglass. / Right, Fig.340 Centre for Gerontology, Bad Tölz, Germany. Clad in ETFE-foil. 2003. / Below, Fig.341 Beijing National Aquatics Center. Clad in ETFE pillows. 2008.



Fig.340

resistance to chemicals, superior fire rating, resistance to ultraviolet light, and light reflectance” (ibid.). However, at the same time it is less elastic, and much more consideration of the connecting systems and structures is necessary. In recent years, there has been great development in PTFE based material, and a highly translucent product that can be folded and made rainproof with special coating has been made (ibid.).

Foil material is also used as weatherproof fabric. ETFE foil is most commonly used, and when chemically inert, they can stand ultraviolet light and atmospheric pollution (ibid.) (fig. 340). The foils are layered two or three times to create pillow structures. ETFE foil is a lightweight substitute for glass, can be fully recycled, and even has a self-cleaning surface. It can also be printed on, and tinted to manipulate different levels of translucency. By altering the air pressure of each pillow, “opaque graphics printed on one layer cover or uncover another” (ibid.). The pillows can also be configured to change its color (fig. 341).

Although technical textiles are designed to withstand outdoor conditions, precautions still must be taken. Fabric architecture often fails from ponding, meaning the pooling of water on the fabric (ibid., p.43). When the collected water freezes, it is fatal for the fabric. Weatherproof textiles must also consider snow-loads. Therefore, in the cold weather conditions of Finland, not much textile architecture is to be seen.

Technical textiles are, however, also used in less extreme conditions, for example indoors. There are still various requirements in interiors, and technical textiles are optimal for heavy usage in general. They have also become less unnatural and more appealing, as seen in the following examples. The somewhat unsympathetic membranes that used to dominate tensile structures are now less common.



Fig.341



Fig. 342

Examples, Details and Possibilities

1. *Tensile structures transformed*

As described in Chapter 2.8, Frei Otto was a pioneer in textile architecture. The shapes of his tensile structures were based on natural phenomena (p. 75). However, with progress in structural engineering, shapes of various scales and curves are now possible. Fewer limits have led to new applications of textiles in architectural scale.

For example, the Tubaloon by Snøhetta resembles an over-scaled musical instrument (fig. 342). The structure can be stored and deployed annually. Furthermore, awnings are now positioned and stored in various ways, like at the Rothenbaum Center Court and Commerzbank Arena (fig. 343, fig. 344).

Smaller elements gather to create a stunning landscape at a mosque in Saudi Arabia (fig. 345). Numerous convertible umbrellas, its designs inspired from traditional patterns, are assembled to open and close according to the weather forecasts. Since separate elements cover the open courtyard instead of one large textile, they maintain the character of the courtyard's original openness.

Tensile structures enhance architectural interiors in the following two projects. In longitude 131, the curvature of the roof textile becomes the curved ceiling inside (fig. 346). The colored windows of the Andreas Paulus PP

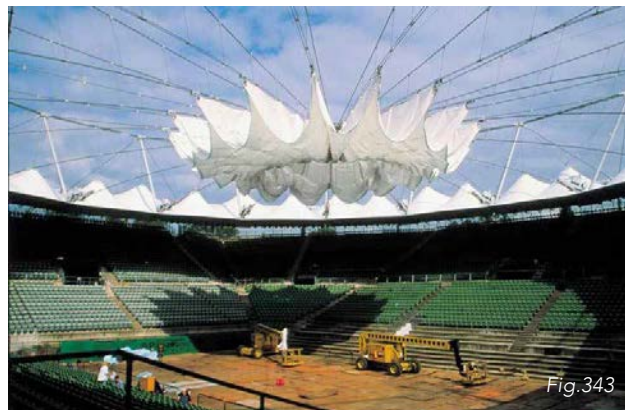


Fig. 343

Rothenbaum Center Court, Hamburg, Germany
Schweger and Partners, roof construction
by Werner Sobek
1995-1997
Translucent white PVC-coated polyester

Tubaloon, Kongsberg Jazz Festival, Norway
Snøhetta
2006
White Ferrari PVDF coated PVC fabric



Fig. 344

Commerzbank Arena, Frankfurt on Main, Germany
GMP Von Gerkan, Marg and Partners Architects
2002-2005
PVC-coated woven polyester, steel cable membrane



Fig. 345

The Prophet's Holy Mosque, Madinah, Saudi Arabia
SL-Rasch GmbH
1993
White Teflon membranes



Fig.349

Luna Rossa team base, Valencia, Spain
Renzo Piano Building Workshop
2005-2006
Used sails



Fig.347

Andreas Paulus Petrus Parish Church,
Maassluis, Netherlands
Mari Baauw, René Olivier (Royal Haskoning)

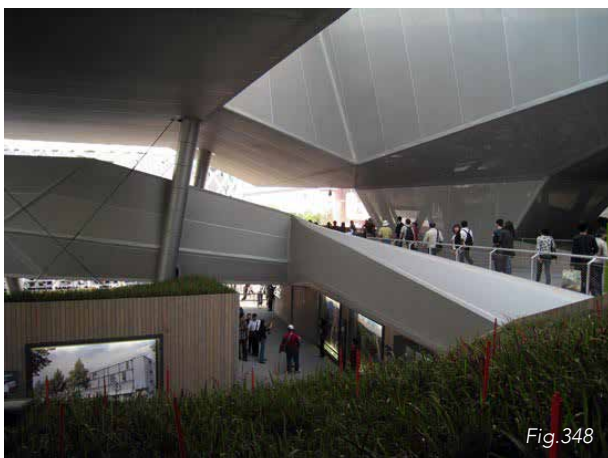


Fig.348

German Pavilion at Expo Shanghai, China
schmidhuber + kaindl
2010
Stamisol (recyclable textile)



Fig.346

longitude 131, Sydney, Australia
Cox Richardson Architects, structural
engineering: Robert Bird & Partners,
fabricators: Taiyo Membrane Corporation
2002

Church add chromatic light to an otherwise white space (fig. 347). In the future, permanent structures like churches and schools, which were always built in heavyweight materials, could perhaps be made more frequently with lightweight textiles.

When textiles are used in exterior facades, they must be weatherproof. The German Pavilion at Expo Shanghai uses Stamisol, a durable textile that is also recyclable (fig. 348). Its intertwining structure creates vague spaces between interior and exterior. The Luna Rossa team base uses laminated used sails as the façade (fig. 349). This project illustrates how textiles are now durable enough to be used twice in different situations.

As these examples denote, textile architecture is transforming into various forms that are less temporal and focus more on creating spaces for the human experience. It is worth observing how even more humanity and warmth will be introduced into tensile structures in the future. Furthermore, textile architecture could become very personal, acting as a transportable living space for the new urban "nomads." Perhaps a portable structure in between a traditional tent and textile architecture would be highly convenient for people constantly on the go.

BMW Guggenheim Lab, Berlin, Germany
 Atelier Bow-Wow, MAGMA Architecture
 (local architects)
 2012

2. *New textures to weatherproof materials*

Although sustainability is an inevitable idea that needs to be considered in every type of building, temporality is acceptable for certain occasions. In these types of projects, highly technical textiles are too costly and are not necessary, and instead alternative materials are experimentally used, also outdoors. The following examples open our eyes to the new possibilities that textiles and similar materials could have in our built environment.

BMW Guggenheim Lab was a temporary textile box that seemed to float on top of even lighter textiles (fig. 350). The contrast of the two textiles clearly suggests that the bottom layer, with its round curtains, is inviting people to enter. Its ephemeral look contrasts with the actual structure of the building, which was made of carbon fiber.

Additional power, such as vacuuming, can alter the surface of a tensile structure. The “Nautilus” fair stand in Dusseldorf retained its shape with a vacuum, creating haptic wrinkles (fig. 351)

Plastic materials are cheap and durable, but are often avoided when its cheap look would have negative effects on the overall scheme. However, RCR Architects used this plastic to create a fresh atmosphere for a restaurant in Spain (fig. 352). The transparent roof and walls allow maximum amount of natural light to flow into a picnic-like setting. Another example is a mobile tent designed by Tetrarc and Concept Plastique. Here, a transparent PVC lens covers a metal structure, which is supported below by a giant oak (fig. 353). The combination of synthetic material and natural object create a provoking dialogue.

On the other hand, natural materials continue to “breathe” when exposed in outdoor climates. However, for the temporary Spanish Pavilion of the Shanghai Expo, EMBT designed a dramatic wicker façade supported by a steel structure (fig. 354). Here, woven wicker units are connected to create a bark-like surface, which also lets soft light imbue into the interior (fig. 355).

In the future, it is probable that various cheap materials will be used for temporary structures. Materials that are only suitable for interiors could be easily treated with waterproof finishes, allowing its use in exteriors as well. However, chemical finishes may not be environmentally suitable, and careful consideration between cost and environmental effects should never be disregarded.



Fig.350

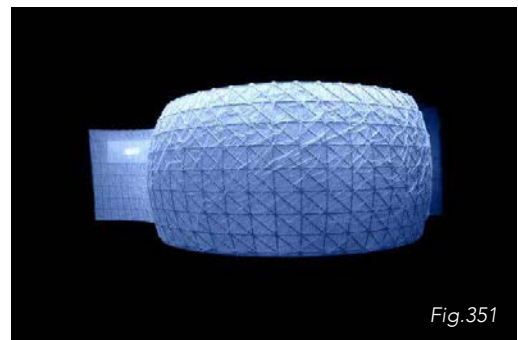


Fig.351

“Nautilus” fair stand of the Mero company,
 Euroshop, Dusseldorf, Germany
 Werner Sobek
 2002
 Plastic foil



Fig.352

Restaurant Extension Olot, Spain
RCR Architects
PVC membrane, plastic



Fig.353

"Aux arbres, citoyens," Nantes, France
Tetrarc and Concept Plastique
2003-2006
Inflated transparent PVC, metal, oak



Fig.354



Fig.355

Spanish Pavilion, Shanghai Expo, China
Miralles Tagliabue (EMBT)
2010
Wicker, steel

3.1.6 Structure Function

Basics of Textiles as Structures

In this section, textiles as “structures” do not refer to textiles that function as building elements of the architecture, such as the tensile and pneumatic structures discussed in Chapter 2.8 and 3.1.5. This structure function points towards textiles that act as structures for other objects, not the building itself. For example, textiles with net structures have long been used to support the growth of plants, and textiles with certain porous or elastic properties are often used to support injured parts of the body. Textiles, with its inherent softness, can cover any shape with a certain tightness, allowing the inside objects to be secure but simultaneously stay free and movable. Furthermore, textiles are resilient, and can retain its original shape after undergoing pressure.

Geotextiles are also an example of textiles that act as structures. They keep soil and other particles intact and prevent them from erosion. Although hidden under ground, the flexible, functional and three-dimensional structures of geotextiles can actually be inspiring. For example, the company Colbond produces Enkamat, made of Nylon 6 filaments, which has an wire-like artificial root structure that allows vegetation to easily take root (fig. 356). Another product is Armater, which has a flexible honeycomb structure (fig. 357).

Although this group of textiles is only a supportive element in architecture, their functional structures can be referenced for other applications as well.

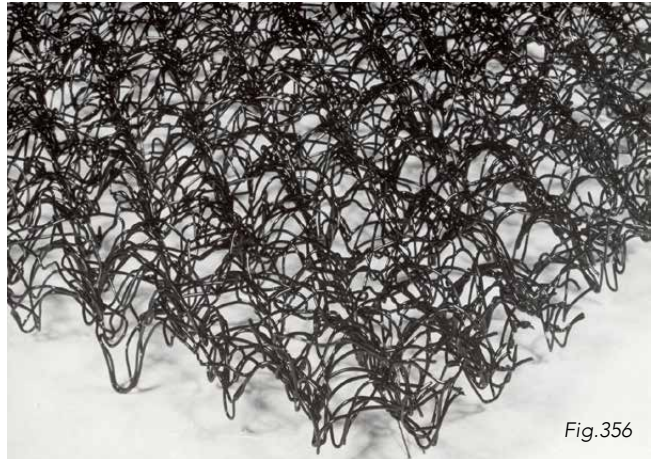


Fig.356



Fig.357

Top to bottom, Fig.356
Enkamat. / Fig.357 Armater.



Fig.359

Spidernethewood, Nîmes, France
R & SIE(N) – François Roche and Stéphanie Lavaux
2007
Polypropylene nets, polyurethane film (walls and ceilings)



Fig.360

NET, Z33, Hasselt, Belgium
Numen/For Use
2011
Flexible nets

Examples, Details and Possibilities

1. Nets

Supportive textiles like nets are often regarded as inferior objects in design projects. However, there are several examples where nets specially function as a building element. One is Spidernethewood by R & SIE(N), which is described as a building “permanently ‘under construction’” (Krüger 2009, p.186) (fig. 358, next page). Here, netting walls distinguish the paths and tames the vegetation around the concrete house, which is also covered in textiles (fig. 359). Besides acting as barriers, the nets will gradually become overgrown by the growing plants, and eventually become green walls. The plants may even stretch out further than the net barriers. The basic net structure communicates the original intentions of the designers, but also visualizes the power of nature as the years pass.

Artists have pushed the limits of nets as well. NET by Numen was a temporary installation in Belgium, where people could climb on to the flexible netted structure and distort its shape (fig. 360). Runa Carlsen transformed plastic nets that are usually used at construction sites into a large-scale art piece (fig. 361). An orange fencing acts as a base structure, and blue netting was woven in to create a purple fabric look from afar.

Nets are useful and utilized in many places; its function varies from keeping animals together to preventing humans from falling from high places. These nets often disregard the aesthetic possibilities, so there are still many design opportunities in this field.



Fig.361

The New Hotspot, Bjørnvika, Oslo, Norway
Runa Carlsen
2009
Plastic fencing and netting



Spidernethewood, Nîmes, France
R & SIE(N) – François Roche and Stéphanie Lavaux
2007
Polypropylene nets, polyurethane film (walls and ceilings)



Fig.358



Fig.362

Prada Transformer, Seoul, South Korea
 OMA
 2009
 Elastic, translucent white PVC membrane



Fig.363

2. Unconventional textile structures

Some architects have come up of entirely new concepts with textiles, which support other elements in unthinkable ways. The OMA Prada structure, for example, is made of a white elastic membrane (fig. 362). Its toneless surface relates to its concept that there is no evident ceiling or floor – it can be turned on any of its four sides. This allows the interior surfaces to be fully utilized (fig. 363). This efficient tensile structure has no orientation, and phenomena like this could happen more often in the architecture of the future.

A simpler, understandable example is the United Bamboo Store in Tokyo (fig. 364). Here, a PVC skin stretches to become the ceiling, walls, shelves and desks. All of these elements also become lighting systems, as the textile is lit from behind.

On the other hand, there is a possibility that textiles could become actual building materials, with similar properties to conventional elements such as wood, concrete and steel. Textile waste is a pressing issue nowadays, and textile designer Päivi Grönqvist wishes that these large amounts of used textiles could be efficiently utilized in architecture. She further states that textiles could perhaps literally become architecture elements; not like the additional objects of today, such as curtains, rugs and upholstery fabric, but actually used when the building is being constructed. Hopefully, a fundamental change is brought to the realm of textile waste, resulting in even more sustainable and comfortable environments.



Fig.370

Fig.364

United Bamboo Store, Tokyo, Japan
 Acconci Studio
 2003
 PVC membrane

3.1.7 Other Functional Roles

The roles, types and applications of spatial textiles, in fact, seem endless. Besides the most common functions described above, textile material has been used both historically and contemporarily in various contexts.

For example, when humans are shown a white, square sheet of fabric on a wall, many of us will regard it as a screen to project an image. When hearing the terms “fabric” and “architecture,” some people may first imagine scaffoldings on construction sites. These and other functional textiles are used in close relation to a building without much consideration. Like the nets described in Chapter 3.1.6, they still provide potential possibilities for design intervention.

A newer, technical approach can be observed as well. Textile fibers, which can easily be woven together to create large surfaces, now can have conductive, resistive or state changing properties (Ramsgaard Thomsen and Bech 2011, p.12). These are termed actuated materials, which can “intensify colour, absorb energy, emit light or heat or stir movement” (ibid.). The inherent characteristics of textiles can be integrated with switches and sensors, therefore amplifying the possibility of textile membranes. A quote by Michelle Addington in *Textile Logic for a soft space* states that “[w]hereas standard building materials are static in that they are intended to withstand building forces; smart materials are dynamic in that they behave in response to energy fields” (ibid.). In Addington’s opinion, architecture design could be less about creating models and realizing abstract ideas into space, but more about “a deep understanding of materiality and behaviour” (ibid., p.13). Certainly, activated membranes and reactive surfaces would be a new starting point for architectural design, and even the “emancipating curtains” and “flexible dividers” explored above will then seem static.

In the fashion field, e-textiles have already gained a considerable amount of attention. The intensely fast speed of fashion trends may be capable of – or even need – these e-textiles, which do not maintain one state through its entire lifespan. However, there are still many uncertainties about actuated materials. Although many people are interested in this emerging field, there are still skeptical voices about how much we allow technology to overtake our everyday lives. Textiles will most likely be cherished for its soft, tactile and humane properties for generations to come. Functionality is nevertheless important, but I believe it should never neglect humans’ fundamental relationship with textiles.



Fig.365

Pleinmuseum, different cities in Europe
Pleinmuseum Foundation Amsterdam
2004-
Steel poles, canvas

Pavilion, Cooper-Hewitt, New York, USA
FTL/Happold
1998
Translucent PVC-coated polyester cloth
with flexible, thin-film photovoltaic panels



Fig.366

Examples, Details and Possibilities

As explained above, textiles are often used as screens for projection. A modern take of the textile screen is the Pleinmuseum, which is a portable museum that has been erected in various European cities since 2004 (fig. 365). During the daytime, nothing happens to the “white box,” which the Pleinmuseum resembles. Once it gets dark, its walls become projection screens, and a truly accessible museum is opened.

Electricity generation is a textile role that would support our technology-dependent lives. As early as 1998, FTL/Happold created a pavilion made of fabric that incorporated photovoltaic panels (fig. 366). These were laminated to a PVC-coated polyester cloth (Drew 2008, p.34). There are currently various flexible solar panels that can also be integrated into soft surfaces like fabrics, but they are not perfectly designed to withstand stretching and bending. A recent development is the production of spherical solar cells, which can be connected to conductive yarns and be actually woven as a fabric (fig. 367). Although these bead-like solar cells are not available for public use yet, photovoltaic textiles may be manufactured quite soon.

Kennedy & Violich Architecture is a firm that conducts research into soft spaces, and proposes textile-integrated buildings. A smaller, realized prototype is their Zip Room in collaboration with furniture manufacturer Herman Miller (fig. 368). The textile wall of the Zip Room can “generate and conduct low-voltage DC power, store and access digital information, and emit digital light” (McQuaid 2006, p.99). If the energy produced is sufficient, these small, individual textile environments can easily be implemented and favored in various environments.

A field yet to be explored would be textiles that support the more profound needs of human beings. By incorporating dynamic materials, textiles could sense, save or even take care of humans in the future.



Fig.367



Fig.368

Zip Room
Kennedy & Violich Architecture, Herman Miller
Double needle bar 3-D raschel knit of 90 percent PET polyester and 10 percent elastomer with optical coatings

3.2 Aesthetic and Atmospheric Roles

3

“If I’m asked to make something in the house, I never work only for the functional role...”

- Outi Martikainen, 2014

2 C

Textiles are not only functional. They can be aesthetically pleasant and emotionally comforting, and add certain atmospheric feels to architectural space. In other words, they “add more.” If textiles only had the functional roles that were explained in Chapter 3.1, they would not have been used in our surrounding environment to this extent. Although these aesthetic and atmospheric characteristics are difficult to define and are sometimes personal, most designers who use textiles know that they are using textile material because of these reasons as well. For example, textile artist and designer Outi Martikainen understands that when architects ask to collaborate with her, they are not hoping to add a textile that merely functions technically. She is referred to as “the artist” at construction sites; therefore her insight will add an additional, emotive layer to the building with its many realistic restrictions.

Furthermore, although human perception is personal and differs with each individual, architect Tiina Parkkinen believes in designing atmospheres through spatial interventions. She refers to textiles as material that “changes the atmosphere and the room, the space,” and this can trigger changes in people as well (2015). Textiles are even capable of affecting the most hidden, inner emotions of human beings.

There are various insights toward textile materials, however, and some architects even strictly avoid its use in their perfectly controlled buildings. The following roles and examples aim to disclose the wide possibilities of textiles in architectural space, and to explore ways that spatial textiles can be integrated with architectural concepts.

3.2.1 Light and Transparency

“I think these curtains, or fabrics or structures... that creates the emotion.”

- Tiina Rytkönen, 2014

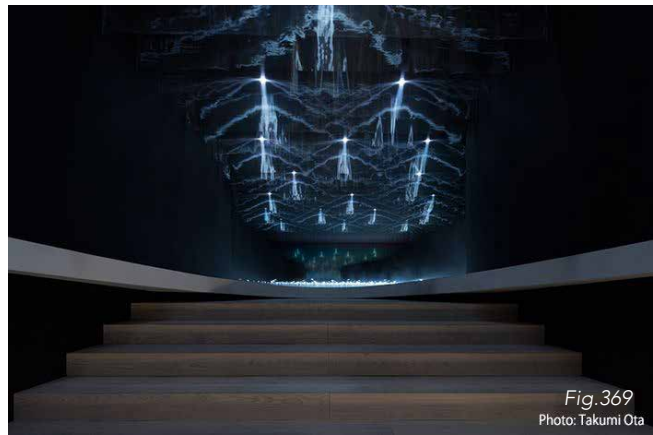
Basics of Light and Transparency

Light control is a functional role of textiles, described in Chapter 3.1.1. However, light is not always simply a good or bad matter that needs certain regulation.

Firstly, the general term “light” refers to several different kinds of light. When correctly termed, *sunlight* refers to the light emitted from a visible sun. It has a certain direction and the light contains the full color spectrum (Coles and House 2007, p.120). On the other hand, *daylight* describes any “light that is produced whenever the sun is above the horizon,” and does not necessarily have to be visible (ibid.). Light is also emitted from sources other than the sun, and artificial lights are sometimes more prominent than natural light in interiors. There is also reused or indirect light, which is reflected from other elements in the space. Numerous spatial textile examples that incorporate lighting systems exist, and will be explored below. Besides conventional incandescent and fluorescent lights, fiber optics and LEDs can be detached from a static surface, leading to entirely novel ways of integration with textiles.

Secondly, textiles not only regulate unwanted light; they can also capture, reflect, alter, amplify or generate light in various ways. These effects directly relate to the atmosphere of the space, as described by interior architect Tiina Rytkönen. She states that “curtains or hanging textiles...affect the emotions, because they affect the light” (Rytkönen 2014). When textiles are placed in a space with many hard surfaces, not only is the textile material itself soft, but the light that shines through or reflects from it creates the soft atmosphere. This also means that additional soft material would not necessarily make a space “soft,” if the lighting expressed a harsher ambience.

When textiles reflect light, there is a certain luster of the fabric, depending on the material, texture, direction



of the light, and amount of light waves reflected from the surface. Examples of shiny materials are lurex and yarns with reflective glass beads (Hemmings 2012, p.28). Delusterants are sometimes used to eliminate excess reflection. Furthermore, retro-reflective textiles can reflect light even with low degrees of illumination (Missakian, Nichols and Wong 2013, p.97).

When textiles allow light through, there is a certain openness or transparency to the fabric. Details of the openness factor are described in Chapter 3.1.1. In addition, the transparency of textiles can be manipulated after the textile is produced. For example, etch printing or burn-out finishes dissolve or burn parts of cellulosic fiber, resulting in a sheer pattern (Nielson 2007, p.103).

Textiles also can become the light source itself. Woven fiber optics, LEDs and electroluminescent wires can emit light, and are increasingly used in various applications.

It can be presumed that light conscious textiles will dramatically change our interiors in the near future, hopefully both aesthetically and sustainably.

Examples, Details and Possibilities

1. *Light manipulating fabrics*

Textiles are often designed together with light, and are inseparable in the following examples. Fabrics and films with a wet luster create serene atmospheres in the Salone del Mobile installation by Yoko Ando and the My Thread exhibition by Hideyuki Nakayama (fig. 369, fig. 370). Ando's textiles are finished with the sputtering technique, where a thin layer of stainless nanoparticles is sprayed onto the fabric. On the other hand, Nakayama's exhibition design utilized the natural sheer of a material that is normally used as an emergency blanket. Furthermore, semi-transparent textiles create a light gradient in Yoko Ando's textiles for the Chapel of Bleu Blanc and the Arcus Temporum installation by the students of Moholy-Nagy University of Art and Design (fig. 371, fig. 372). For her

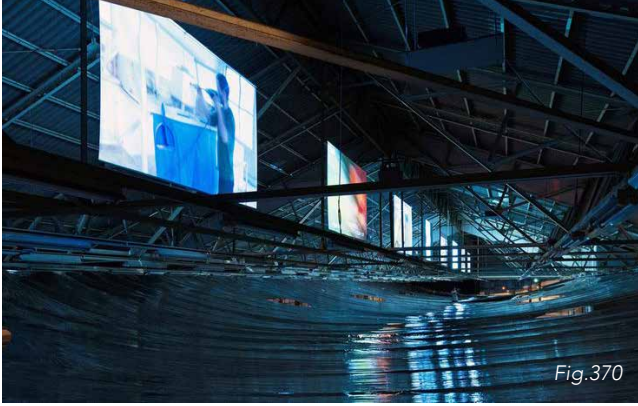


Fig.370

"Infuse," Salone del Mobile, Milano, Italy
Chikara Ohno (sinato, concept and design), Yoko Ando (textile design), Izumi Okayasu (light design), Kaneka Corporation / 2013
Polyester (27 μ m yarn thickness), with metallic sputtering finish on one side, transfer print on the other *Opposite page*

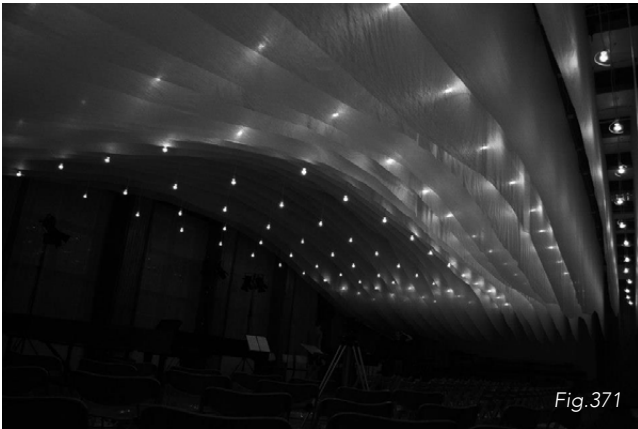


Fig.371

My Thread exhibition, Creative Center Osaka, Japan
Hideyuki Nakayama
2013
Polyethylene terephthalate metalized film (12 μ m thickness)

Arcus Temporum IX, Arch Abbey, Pannonhalma, Hungary
Dániel Baló, Dániel Eke, István Varga and Zoltán Kalászi (Moholy-Nagy University of Art and Design)
2012
Polypropylene nonwoven geotextile fabric

Chapel of Bleu Blanc, Aichi, Japan
Suppose Design Office (Makoto Tanijiri), Yoko Ando
2011

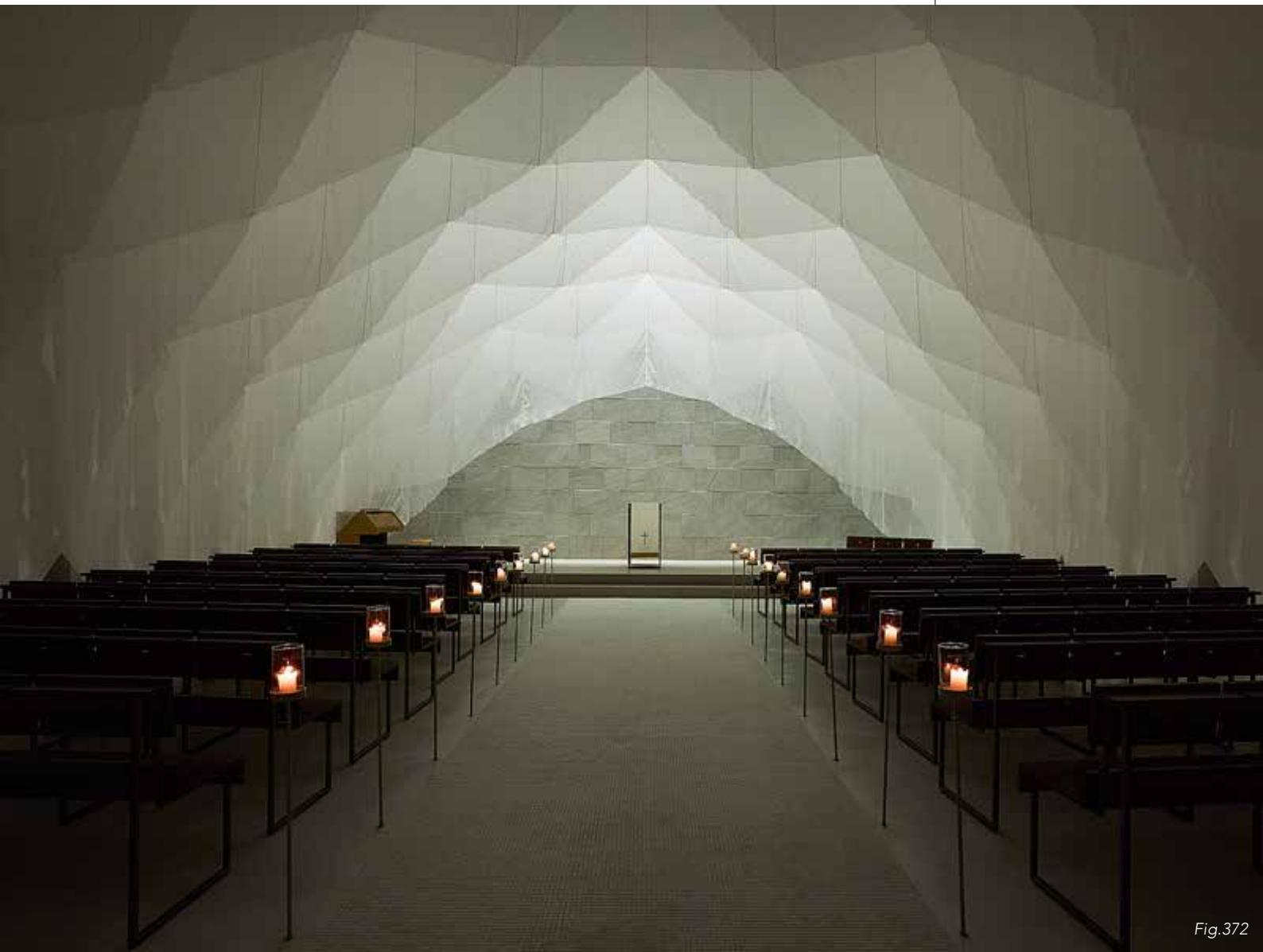


Fig.372

Master's thesis, Maarit Salolainen designed interactive screens for the Liberty Science Center out of copper wire, with each structure reacting differently to light. Furthermore, Christo created an entire space that is defined by light and textile material in the *Big Air Package* project (fig. 373). When inflated, the sculpture is ninety meters high, and the skylights of the Gasometer let in light that is diffused into the spacious envelope. The Lexus installation designed by Japanese Tokujin Yoshioka is also a space that would resemble “nothing” if it were not for the numerous strings that visualize movement and presence (fig. 374).

In Japan, traditional Japanese paper has been used in lanterns to diffuse soft light (fig. 375). This concept has been enlarged in the “Canvas” restaurant renovation by nendo (fig. 376). Here, the concept was to create a total space with one inexpensive material, and thus a canvas fabric covers the exterior, interior, tables and chairs (fig. 377).

Large and small light “holes” play an important role in the curtains of Villa Leefdaal, designed by Inside Outside. With strong daylight, less transparent fabrics reveal a pink polka dot pattern, whereas the black dots have an even smaller pattern of polka dot openings, resulting in bundles of perforated light (fig. 378, fig. 379). Similar elements create differentiated effects according to the various layers of materials and transparencies.

In textile artist Kristiina Wiherheimo's work, textiles alter the color of light. One example is seen in her work “Small Fires,” which combines felt lampshades with small light sources (fig. 380). When light illuminates a dense material like wool felt, the textile absorbs the light and becomes a glowing light source of its own.



Fig.373

Big Air Package, Gasometer Oberhausen,
Germany
Christo
2013
Semitransparent polyester fabric



Fig.374

Lexus L-finesse Installation, Milan, Italy
Tokujin Yoshioka
2005-2006
Fibers



Fig.375



Fig.376



Fig.377

"Canvas" Restaurant, Tokyo, Japan
nendo (renovation)
2003
Canvas fabric

Villa Leefdaal, Belgium
Inside Outside
2003-2004



Fig.378



Fig.379

Small Fires
Kristiina Wiherheimo
1997
Wool and MDF board

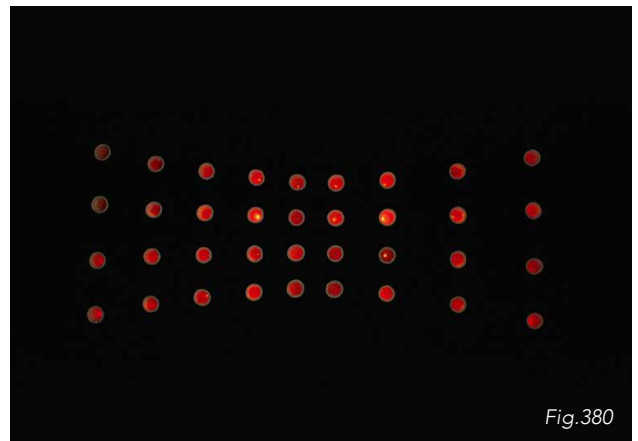


Fig.380



Fig.381



Fig.382
(c) Steen Gylendal

HEART, Herning Museum of Contemporary Art, Herning, Denmark
Steven Holl
2009
Concrete

Tienda Departamental Altabrisa, Tabasco, Mexico
Iñaki Echeverria
2012
Pre-cast concrete



Fig.383

2. *Light manipulating textile-like architecture*

The fluidness of textiles has inspired architects to generate soft shapes that interact with light. Undulating, twisting and curving surfaces characterize some recent works of architecture.

The HEART Museum in Herning, Denmark, designed by Steven Holl, has ceilings that clearly resemble fabric drapes (fig. 381). Actually, Herning's historical connections with the textile industry formed the overall architectural concept. Although the material is stiff, the curves of the ceiling gently reflect light and create shadows similar to those produced with fabrics. Actual textiles were used as well, but indirectly; fabric sheets were "inserted into the formwork to yield a fabric texture to the building's exterior walls of white concrete" (divisare by Europaconcorsi 2005) (fig. 382). On the other hand, Tienda Departamental Altabrisa has a façade covered with twisted elements (fig. 383). Like twisted felt, it also functions similarly to louvers. Furthermore, architect Mikko Summanen refers to the walls of Kamppi Chapel in Helsinki as "a kind of curtain" (2014). The wooden interior acts as a "light curtain" that reflects the natural and artificial light shining from above (Summanen 2014) (fig. 384).

Textile-like architecture is also explored in Chapter 3.2.7 (p.188).



Fig.384

Kamppi Chapel of Silence, Helsinki, Finland
K2S Architects
2008-2012
Wood



Fig.385

Technolace, Paris, France
 Helena Hietanen, Mikko Summanen
 2000
 Optic fiber, steel. Glass box: glass, aluminum.

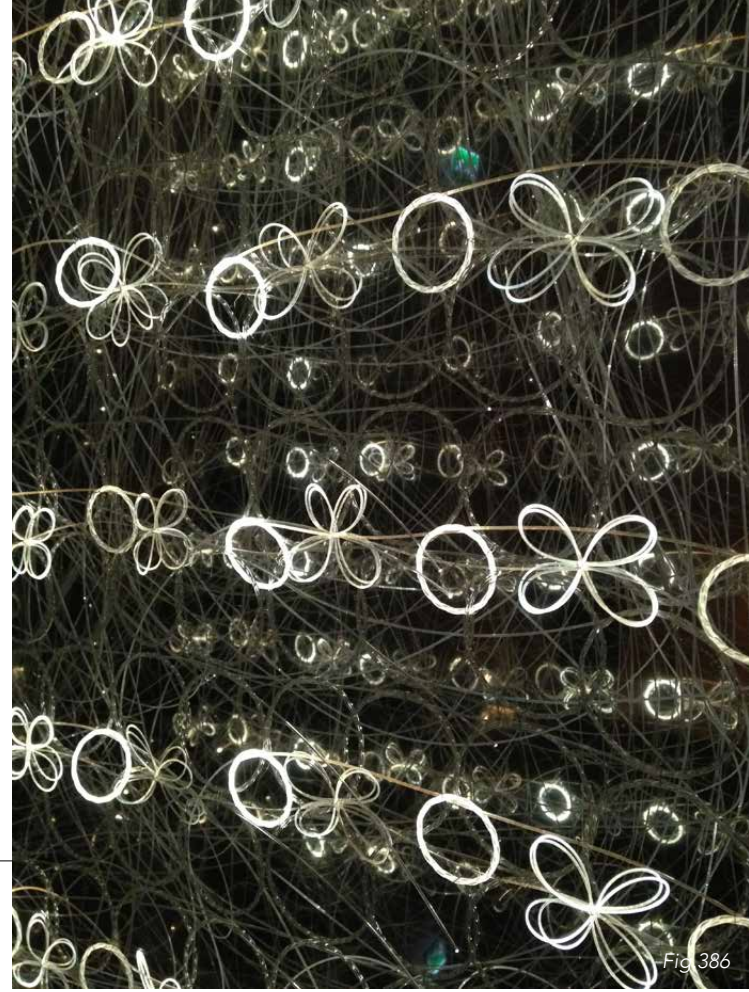


Fig. 386

3. *Light producing/emitting fabrics*

Through expert interviews, I came across many designers who were interested in working with light emitting textiles. Currently, LEDs and other light producing elements can easily be implemented into thin surfaces, whereas in older technology, numerous cords had to be connected to a power source. Furthermore, if light is woven together with technical textiles in a large scale, they could become part of fabric architecture itself. Ceilings and walls would simultaneously act as light sources, eliminating the need of additional electric systems. Textiles and integrated lighting could fundamentally change architecture and its technical necessities.

An early light emitting textile and architecture collaboration is seen in the work of artist Helena Hietanen. Her optic fiber wall was installed in a glass cube, designed with architect Mikko Summanen in 2000 (fig. 385). Hietanen ties together numerous optic fiber yarns together with thin steel, creating a lace surface that is programmed to softly glimmer (fig. 386). Astrid Krogh is another designer who works with optic fiber in large-scale installations (fig. 387). Krogh states that “[i]t is essential for [her] to work with light because we [in Denmark] have so little of it” (Hemmings 2012, p.42). Krogh also focuses on the color of the light, and creates chromatic waterfall-like

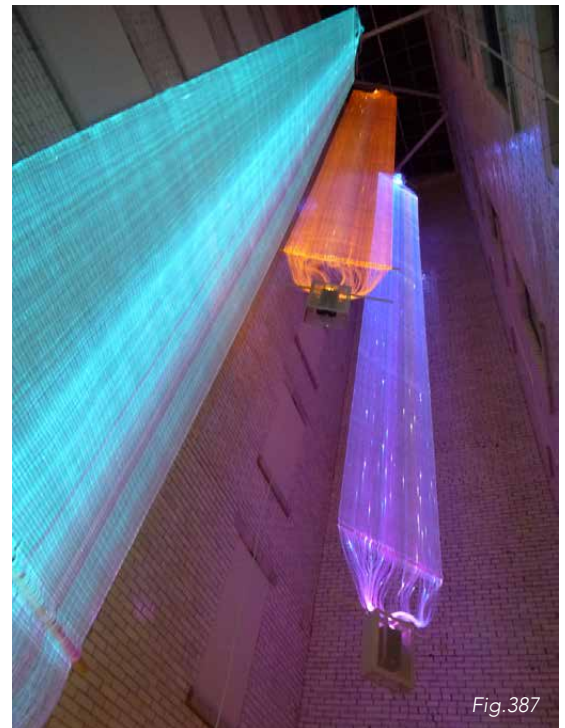


Fig.387

'Lightmail', 21C Museum Hotels, Cincinnati, USA
 Astrid Krogh
 2012
 Optical fiber, paper yarn



Light Installation 1 and 2, Galerie Het Langhuis,
Zwolle, Netherlands
Tamar Frank
2006
Nylon monofilament with UV tube lighting



The Kelleroscope
Christine Keller
2004
Cotton, polyester, wool, iron wire and 3M Retroglo
weft and cotton warp, Jacquard weaving

banners.

There are also many artists who create light related textile works without using optic fiber. Materials vary from nylon monofilament by Tamar Frank to 3M Retroglo yarn by Christine Keller (fig. 388, fig. 389). These two works are not actually producing light, but is visually activated with the presence of a light source. Fluorescent light is combined with natural materials in the work of Marianne Kemp (fig. 390). Technology and art are combined in Elin Igländ and Maggie Orth's works (fig. 391, fig. 392). Orth's "100 Electronic Art Years" questions this exact relationship; this textile piece changes color, but eventually the bright colors will be burned into the surface, leaving a trace of software into an artifact (Hemmings 2012, p.60).

Moreover, Loop.pH is a studio based in London, designing spatial interventions for both public and private clients (fig. 393). They often work with Archilace, which is a large-scale lace made of strong composite fibers. Loop.pH succeeds in referencing structures from nature and combining them with both traditional techniques and new, light emitting material.

Currently, it is still rare for light producing textiles to have actual technical functions in architecture. In the near future, they may start to replace conventional lighting systems. The more they are integrated, the more they allow freedom in interior space. Like the personalized light wall designed by Jonas Samson, furniture, curtains and other interior elements may soon have an additional lighting function (fig. 394).



Ecco Luce
Jonas Samson
LED-lights

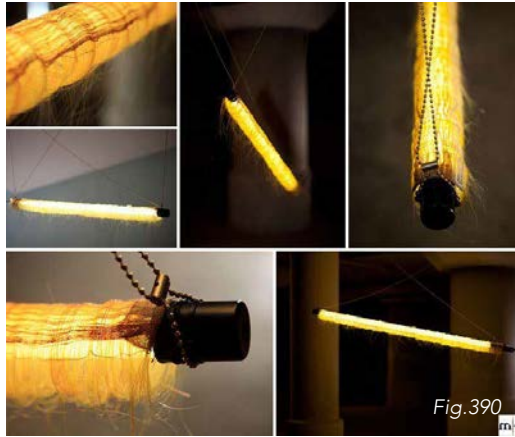


Fig.390

Ray Light

Marianne Kemp

2011

Horsehair weft and linen warp with fluorescent tube, weft-faced plane weave, Lervad loom



Fig.391

Pattern Examination of Sound No.1: Piano

Elin Igland

2009

Wool warp and weft, hand-woven plain weave, piano, cables, electronic components

100 Electronic Art Years

Maggie Orth

2009

Hand-woven cotton, rayon, conductive yarns, silver ink, thermochromic ink, drive electronics and software

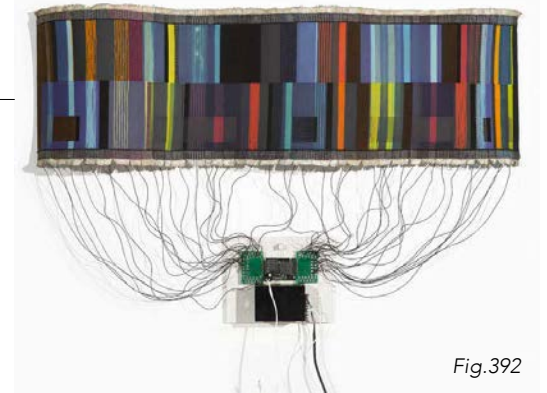


Fig.392

Secret Garden Party, Cambridgeshire, England

Loop.pH

2014

Composite fibers



Fig.393

3.2.2 Spatial Placement and Scale

Basics of Spatial Placement and Scale

Textiles can be placed in architecture in infinite ways. We now see curtains paired with windows in almost every contemporary building, but it was only during the twentieth century when simple, rectangular fabrics became the norm. In the long history of our living environment, textiles used to be positioned more freely within architecture, covering, circulating, draping, and hovering over humans.

Architecture has taken a new level of transformation with the introduction of computer generated forms, and concurrently a diverse arrange of interiors has developed. Consequently, textiles have begun to be created and modified to fit certain needs or accommodate specific atmospheres. A textile can easily affect, or even guide human movement in spaces, depending on the way it is applied. Thus, it can be highly effective to design the textile itself in relation to the planned site.

In addition, there are currently less limitations in application hardware than before. For example in curtains, conventional straight rods are still used, but curved, minimal designs are available as well, and becoming more commonly used.

Furthermore, when designers decide where and how to place textiles in space, they will often consider its scale in relation to its surroundings. Normally, the site where the textiles are designed is a completely different environment from the planned installation site. It is thus essential to both imagine and produce a simulated image of the end result in its final context. Textile artist Outi Martikainen also emphasizes the importance of experiencing the planned site in advance, “to ... feel the amount of room there is” (2014). Human perception is a very delicate sense, and even the smallest changes in size, structure and color of a fabric can generate different feelings. It is also a challenge for textile designers to imagine large-scale projects in its final state, as the initial samples and experiments are usually smaller (Salolainen 2015). Even if the material and structure were the same, a textile twice as large would both look and act differently. For example, two different colored yarns may be distinguishable from near, but would merge into one color from afar.

Overall, textiles are greatly affected by its way of placement. Although this is an ordinary fact to consider in site-specific projects, the imagining of an actual building or interior can also be effective in designing mass-produced textiles as well.

Kunsthall, Rotterdam, Netherlands
OMA, Inside Outside
1992

Robe eats column, flirts with Metasequoia.





Chazen Museum of Art, Madison, USA
Machado and Silveti Associates, *Inside Outside*
2008-2011

Translucent Trevira CS Voile, digitally custom-printed, and laser scrim and gray silk

Examples, Details and Possibilities

1. *Innovative placements of textiles*

Textiles can be placed freely according to any intended function. The following examples demonstrate how designers can experiment with various ways of application, with little confinement seen in conventional methods. Although an early example, the Kunsthal in Rotterdam is still inspiring, in that it demonstrates the possibility that spatial textiles can be more interactive. The curtain “does not hang in the traditional position between audience and stage ... and when unrolled, it slides into the hall encircling the audience” (Heuvel 2006, p.282). Here, rather than the stage, the audience and the entire hall is framed (ibid.). The slanted roof affects the different heights of the curtain, which also becomes a soft, curling column when opened (fig. 395, previous page). Inside Outside also designed freeform rails in the Chazen Museum of Art (fig. 396). Here, when pulled, the curtain wraps around a linear lamp, becoming a glowing column (fig. 397).

Yarns can sometimes more intriguing than closed fabrics, as various colors and transparencies can be manipulated through the installation process. Even though the on-site process requires an enormous amount of patience, architects and artists alike have used this method. For the Serpentine Gallery Pavilion in 2007, artist Olafur Eliasson collaborated with Kjetil Thorsen of Snøhetta to create a transforming visual effect with twisted cords (fig. 398). It is designed so that every move of the visitor changes the view of the pavilion. Architects Barkow Leibinger also used tensioned yarn in their Loom Hyperbolic (fig. 399, next page). The local technique of traditional weaving inspired the architects to integrate wooden frames and yarns with current algorithm software, resulting in a soft but highly three-dimensional structure. The installation by Esser # Horn in Düsseldorf plays with a large atrium by creating an imaginary staircase with haptic yarns (fig. 400). Spatial yarn installations such as Gravity’s Loom and Promenade illustrate lines of color in architectural space (fig. 401, fig. 402). The thinnest of materials can create amazing effects when combined, and the time-consuming work instinctively arouses “visitors to be more intensely aware of their surroundings” (MacMurray, qtd. in Hemmings 2012, p.18).



Serpentine Gallery Pavilion, London, England
 Olafur Eliasson, Kjetil Thorsen (Snøhetta)
 2007
 Polyester cables

Fig.398



Fig.400

"Treppenhaus" (Staircase) installation, Stilwerk
 Düsseldorf, Germany
 Esser # Horn
 2002

Gravity's Loom, Indianapolis Museum of Art, USA
 Ball-Nogues Studio
 2010
 Ink-dyed nylon twine installation



Fig.401



Fig.402

Promenade, Kedleston Hall, Derby, England
 Susie MacMurray
 2010
 Cotton thread installation



Fig.399

Loom-Hyperbolic, Marrakech Biennale, Morocco
Barkow Leibinger
2012
Pine poles, steel plates and tubes, yarn



Fig.403

Boundary Window, Tokyo, Japan
Shingo Masuda + Katsuhisa Otsubo Architects
2014

Berkhan House, Grosselfingen, Germany
Fischer Berkhan Architects
2006
PE-ribbon weave



Fig.404

2. *Textiles altering the sense of scale*

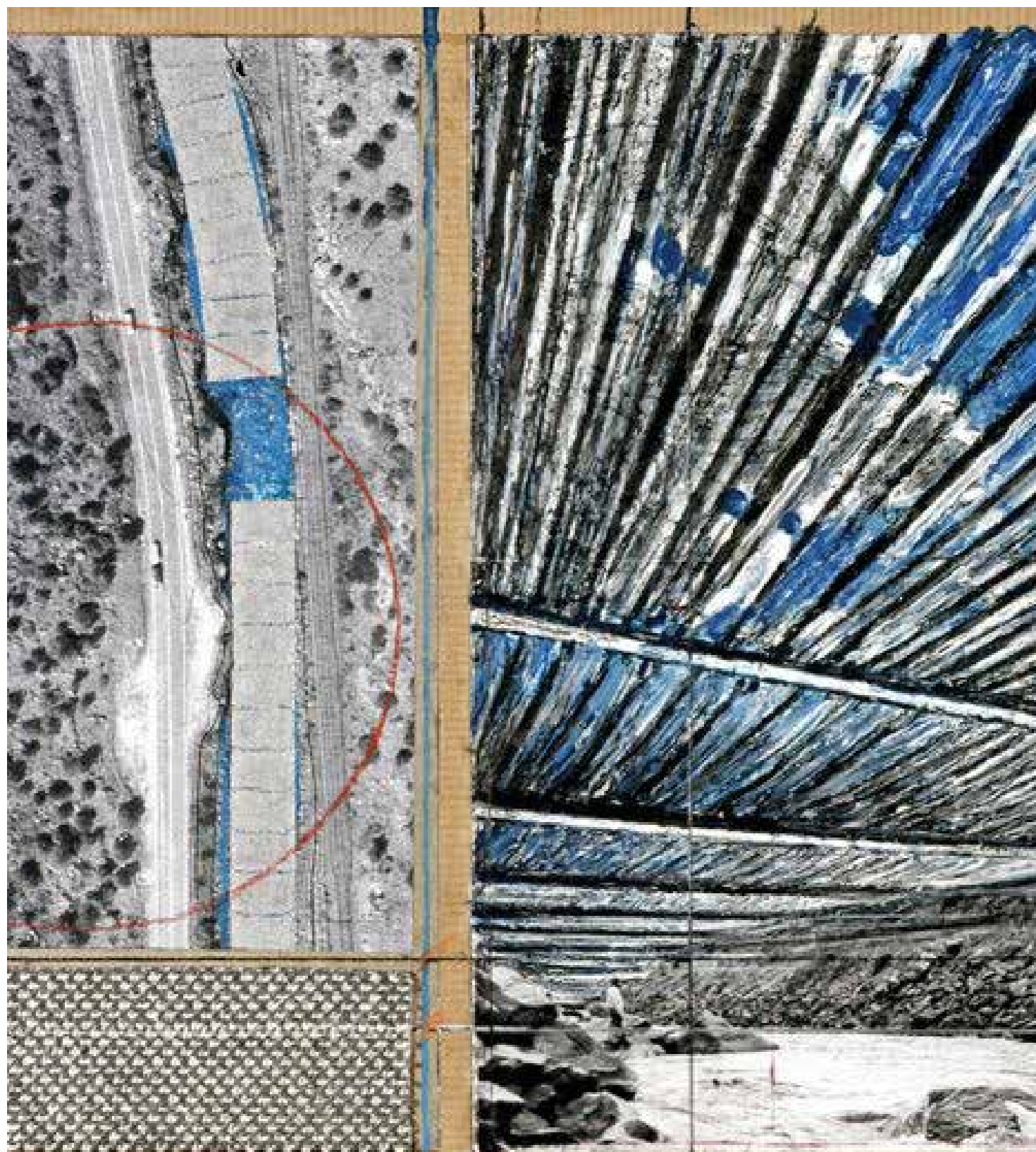
Architectural scale is often naturally embedded into our bodies. We usually have a general idea of window sizes and curtain sizes, or how high a ceiling can be. When these instincts are shattered with either extremely large- or small-scaled spaces or objects in relation to its surroundings, we can be surprised and become even unsteady at times. The altering of a common scale that is familiar to humans can be utilized to create positive spatial effects, if done correctly. For example, curtains are usually placed to cover one area of an interior wall. However, in the Boundary Window by Shingo Masuda + Katsuhisa Otsubo Architects, large-scaled curtains are draped to cover more than two stories of a house's height (fig. 403). Here, a new glass box surrounds the existing building, but the height halfway up is not equal to the line separating the old building's floors. This slight variance is further emphasized with the overly scaled curtains. Textiles this immense sway slower than when implemented in smaller amounts, which also alters a person's sense of time. The curtain facades of the Berkhan House also differ from the usual scale of a curtain (fig. 404). In addition, the curtains can be moved freely to create different degrees of privacy on the balconies.

When it comes to over-scaled textiles, Christo and Jeanne-Claude must not be forgotten. They have covered monuments, entire buildings, interiors, rivers, and even bodies of water with textiles (fig. 405). With their large-scale projects, they encourage visitors to "see and perceive the whole environment with new eyes and a new consciousness" ("Christo and Jeanne-Claude FAQ"). "Over the River" is an ongoing project, and 9.5 kilometers of silvery translucent fabric panels are planned to cover eight sections of the Arkansas River (fig. 406, next page). Although materials other than textiles could also be used, Christo explains in a lecture in 2010 that "the fabric is the principal material to translate the fragile, nomadic quality of our projects." He also mentions that "with the fabric, you can see the wind," whereas without it, you would only feel it.



Fig.405

"Wrapped coast," Little Bay, Sydney, Australia
Christo and Jeanne-Claude
1968-1969
One million square feet of erosion-control fabric



V. M.

2009

Swiss-Led Federal project (paperwork) width +
80-250' length above (under) River level

Over the River (Project for Arroyos River, State of Colorado) In



"Over the River," Arkansas River, USA
 Christo and Jeanne-Claude
 1992- ongoing
 Silvery translucent fabric panels

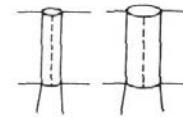


Figure 10.5c Cartridge pleats in small and large sizes

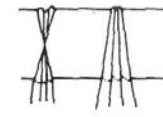


Figure 10.5e X-pleat and inverted French pleats

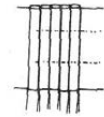


Figure 10.5k The pencil pleat is accomplished with sewn-on or fused-on tape. Strings are pulled to form the pleats.

Fig.410

3.2.3 Pleating and Layering

Basics of Pleating and Layering

Since antiquity, textiles have often been used with more than one layer. They were also used in generous amounts so as to create pleats with deep shadows for both functional and aesthetic reasons. Furthermore, when textiles overlap, they produce a variety of color shades and transparencies, leading to infinite ways of expression. Architect Tiina Parkkinen mentions this as one of the key characteristics of textile – its “possibility to have different kinds of output” when many layers exist (2015).

Even with a simple drapery fabric, there are various traditional styles that demonstrate the different effects achieved by the act of pleating. The most common pleat seen in residential interiors is the French or pinch pleat, the latter producing sharper folds (fig. 407, fig. 408) (Nielson 2007, p.185). The architectural, accordion or single pleat is a lighter version (fig. 409). Other variations of the pinch or French pleat include the X-pleat, butterfly pleat, cartridge pleat, goblet pleat, and pencil pleat (fig. 410). Each has different folds and additional attachments to realize different effects. Besides pleating, shirring is also a technique that uses abundant amounts of fabric (fig. 411).

Lace curtains, glass curtains and sash curtains are traditionally layered with heavier draperies or top treatments. Top treatments include valances and pelmets, but these are now only used when a specific historical style is preferred (fig. 412). In general, the above examples are uncommon nowadays, but still exemplify the variety of shapes that curtains can take with detailed design alterations.

Furthermore, to create the elegant curves of a draped fabric, the fiber itself can be manipulated. In general, fine, low-twist multifilament yarns are woven in a satin weave to achieve good drapability (Yeager and Teter-Justice 2000, p.250). For a fabric to retain a certain shape and become wrinkle resistant, fabrics undergo durable press calendaring. This is a process where textiles are stretched, resins are applied and then cured in hot temperatures (Nielson 2007, p.102).

Nowadays, textiles are folded and layered in freer ways, depending to the intended function and look. The depths of a textile are combined with the spatial effects in architecture, thus creating even more dynamic and interesting spaces.



From top left to right, Fig.407 Velvet 3-fold French-pleat drapery. / Fig.408 Pinch pleat. / Fig.409 Single pinch pleat. / Fig.410 (left to right) Cartridge pleats in small and large sizes, X-pleat and inverted French pleats, pencil pleats. / Above, top to bottom, Fig.411 Four rows shirring tape. / Fig.412 A Charleston valance.



Fig.413

Art Gallery Showroom, Verona, Italy
Antonio Ravalli Architetti
2010
Non-woven fabric



Fig.415

"Mangekyo IV"
Jun'ichi Arai
1992
Polyester, aluminum (slit yarn)

Examples, Details and Possibilities

1. *Interesting draped and pleated textiles*

Unique pleating can add various dimensions to spatial textiles. For example, Antonio Ravalli Architetti layered pleated, semi-transparent fabrics used for agriculture on the ceiling of an art gallery (fig. 413). If these fabrics were flat and not pleated, less movement would be generated, and there would also be less lighting contrasts. On the other hand, the opening movement of the large curtain in O House in Japan generates shirred pleats (fig. 414, next page). The two-story high textile moves more dynamically than a normal drawing process of a curtain.

Textile artist and designer Jun'ichi Arai of Japan manipulates textiles by folding, pleating and layering (fig. 415). These manipulations affect the outcomes of the chemical reactions induced by Arai, and create distinct textiles that are never reproducible. A few of his techniques include felting, vapor deposition, and "melt-off" (dissolution), and each process results in numerous textures and sheers, also favored and incorporated by fashion designers such as Rei Kawakubo and Issey Miyake.

Textile innovator Samira Boon explored cell structures that were large enough to create human-scale spaces in the project Architextiles (fig. 416). Here, she wove together various materials with multiple weave structures that would create pockets of different haptic qualities. The cellular voids can be stored as a flat textile and opened when necessary. In a smaller scale, Lucy McMullen utilized the characteristics of weaving to create cellular structures to place on the floor (fig. 417). The piece was an answer to a brief to create work that could be folded flat for transport and storage (Hemmings 2012, p.64).



Fig.416

Architextiles, Netherlands
Samira Boon
2012
Banana leaf (abaca), mohair and paper

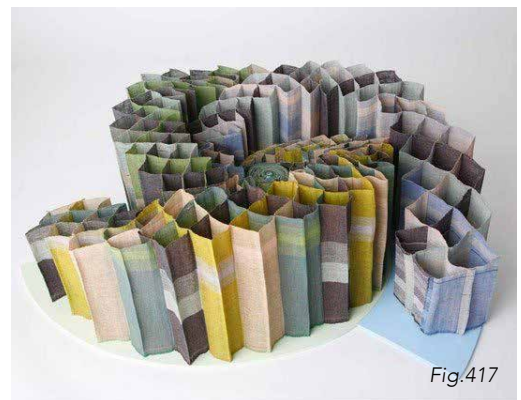


Fig.417

Maelstrom
Lucy McMullen
2006
Shetland wool warp and silk spun cord with a copper core weft, three-section multi-layered pleat, hand-woven on 24-shaft computerized AVL loom



Fig.414

O House, Kyoto, Japan
Hideyuki Nakayama, Akane Moriyama
2009
Cotton, Kevlar rope



Fig.418

Eight layers screen, Nagoya, Japan
Akane Moriyama
2012
Trevira CS, PVC



Fig.419



Fig.420

Travelling showroom, Portugal
ex.studio. Patricia Menses + Iván Juárez
2008



Fig.421

Boa Hairdressers Salon, Zurich, Switzerland
Claudia Meier
2009-2010
Transparent fibers

2. Layered textiles and depth

When semi-transparent textiles are layered, a vague depth of light is created. This effect can soften harsh light sources, and is captivating to many designers. In *Eight layers screen*, Akane Moriyama layered thin fabrics with small openings that visualize the depth produced by the textiles (fig. 418). The travelling showroom in Portugal was inspired by the elliptical door shapes in Lisbon, which was reinterpreted by combining the intense characteristics of sunlight, also a local inspiration (fig. 419). A light enveloping space is visible from one direction, but does not actually exist from the other (fig. 420). On the other hand, layered strings of varying lengths create a tactile ceiling like hair inside *Boa Hairdressers Salon* (fig. 421).

Transparent, translucent and opaque textiles can be layered according to the degree of privacy necessary. This idea evolved into the layered spatial partitions by Sylvie Krüger (fig. 422). Screens with transparent areas on the top, bottom, and in a line in the center can be combined freely, adding an additional trait of flexibility to partitioning textiles.



Fig.422

Textile panels
Sylvie Krüger
2002

Vertical landscape, Museum of Contemporary Art, Sapporo, Japan
Ryo Yamada
2011
White synthetic fiber netting



Fig.423

3.2.4 Way of Movement

Basics of Textile Movement

One of the most striking characteristics of textiles is that they can be so light as to move with the slightest amounts of airflow and human touch. Their slow, soft movement is unachievable with any other material, and they greatly enhance buildings, which can often be motionless. Architect Tiina Parkkinen mentions that “the building always looks different” from time to time when fluid textiles exist (2015). Textiles in motion can be eye-catching but inviting to humans as well. The pliability of textiles questions the architectural design culture itself: “[w]hat would an architecture of movement and state change suggest?” (Ramsgaard Thomsen and Bech 2011, p.15) When movement becomes a central factor in architecture, new coordinates, which are not rigid but in fact transient, arise. Boundaries are blurred, and the entire definition of architecture becomes vague. Furthermore, large-scaled fabrics in air symbolize departure and freedom, for example with sails and flags.

Textiles can be programmed to move and change as well. For example, new materials can react to local environment changes such as temperature and humidity (Hemmings 2012, p.51). Yarns can also have shape memory, independently changing back to its original state. As described in Chapter 3.1.7, textiles can be activated mechanically and electrically as well.

Examples, Details and Possibilities

Most textiles move in one way or another, but the following examples are particularly defined by the factor of movement.

Ryo Yamada designed transparent columns that are blown with natural air (fig. 423). Static elements that are normally seen inside architecture are taken outside, and are emancipated using soft material. Furthermore, architectural scale can be considered small compared to Janet Echelman’s textile mesh. Echelman’s installations float magnificently in the landscape, its lightweight structure always moving in accordance to the wind. In “Unnumbered Sparks,” visitors can paint beams of light with their smartphones onto the net spanning nearly two hundred meters (fig. 424).



Fig.424

Unnumbered Sparks, Vancouver, Canada
Janet Echelman, Aaron Koblin (Google)
2014
Honeywell Spectra Fiber



Fig.425

Reflected Roof, Den Frie Centre of Contemporary Art, Copenhagen, Denmark
Akane Moriyama, Jesper Carlsen
2014
Fabric, fans, computer



Fig.426

Rotation umbrella, Stuttgart, Germany
Werner Sobek with Transsolar
1997-2003



Fig.427

Rotational Pneu, Munich, Germany
Dominik Baumüller
1997
TYVEK polyethylene fleece, electric motor

On the other hand, soft movement is caused by artificial, programmed wind in Reflected Roof by Akane Moriyama and Jesper Carlsen (fig. 425). A large piece of fabric floats into different shapes, and the spaces created below constantly change, becoming a fluid form of architecture.

Since textiles are inherently soft and limp, continuous movement can actually help to stabilize a textile structure. The rotation umbrella by Werner Sobek defines its shape only when a motor initiates its movement (fig. 426). Rotational Pneu by Dominik Baumüller also uses the power of wind to be shaped into a horizontal textile element (fig. 427).

Besides wind, electricity has been integrated into textiles to cause movement in smaller scales. Elaine Ng Yan Ling creates textiles with shape memory alloys that move according to electric currents (fig. 428) (Hemmings 2012, p.62). Proximity and humidity sensors also react to different environments, generating various movements (ibid.).

The natural power of gravity can also induce dramatic movement. The curtain and technical system company Gerriets developed a “Kabuki drop system” that would allow curtains to instantly drop to the floor (fig. 429).

An ideal textile movement could be a change of its shape according to human movement and needs. For example, textiles could automatically gather around loud conversations, or move away to become more spacious when the number of people increases. In the future, textiles perhaps could move into desired positions with more ease.



Fig.428

The Flapper from Techno Naturology
Elaine Ng Yan Ling
2010

Chair cane, wool, polyester and shape memory yarn weft, and wool and cellophane warp, pleated double cloth hand-woven on Dobby loom

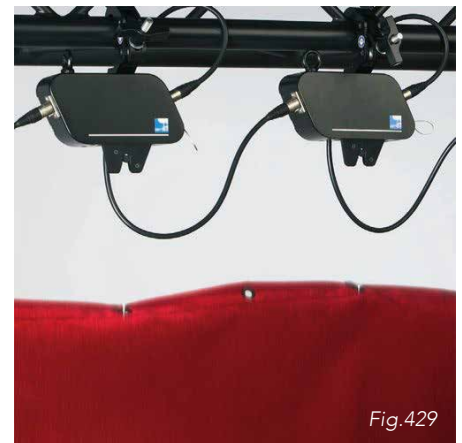


Fig.429

3.2.5 Colors

Basics of Textile Colors

Colors have highly influential effects in architectural scale; to the building itself, the interior, its inhabitants and its surroundings. Colors can be personal, and relate not only to our individual physical traits, but are also altered by personal influences from our surroundings. Furthermore, colors appear different depending on their association, and also according to the lighting conditions. What we see is the *apparent* color. When a color changes under different lighting conditions, it is called the metamerism effect, or metamerism (Nielson 2007, p.139). In addition, the color of a yarn may appear different from that of a woven textile, due to a three-dimensional structure. The texture of a textile also affects its color, as color does not reveal itself in highly reflective surfaces compared to matte surfaces (Wiherheimo 2015). On the other hand, with insufficient colorfastness properties, colors can physically change over time as well. In this case, the *actual* color characteristics change.

Colors are not necessarily selected based on aesthetic preferences, however. Certain colors can have certain functions, and artist Kristiina Wiherheimo states that colors “can solve your problem in a space” (2015). When a space needs color, Wiherheimo may even start with the color, and then decide on the material that fits best. For example, warm and bright colors can be utilized in spaces where daylight is lacking.

When permanent elements of architecture are colored, it may be too dominant within the total design scheme. However, textiles can be applied with ease and less commitment, and thus is optimal when a certain color is lacking. A colored textile is also effective when not much can be altered in an existing environment.

In addition, textiles can achieve virtually any color. However, it must not be forgotten that all natural fibers have an inherent color as well. Wool fibers are black, gray, tan, yellow or off-white, and silk varies from yellow to off-white (Yeager and Teter-Justice 2000, p.45). Linen fibers vary from brown, tan to cream, and cotton has slightly different shades of white (ibid.). These inherent colors are often removed or neutralized when their colors are altered. Besides dyeing and printing, different finishes can alter textile colors in the very end of the manufacturing process. For example, a brightening

Staircase, Istanbul Biennial, Turkey
Do Ho Suh
2003
Translucent nylon



Fig.434



Cubic Prism, Goldsmith Hall, University of Texas Austin, USA
Akane Moriyama
2013
Polyester, metal, PVC, stainless wire

finish can augment the clarity and brightness of a textile (Nielson 2007, p.102).

One must be careful when choosing colors, not only for the differences in personal preference, but also for cultural reasons. In some cultures, colors can have certain meanings, and the wrong choice could lead to negative reactions (Halminen 2015).

Examples, Details and Possibilities

When textiles are arranged three-dimensionally, various colors and transparencies can be combined to achieve intriguing spatial effects. Many designers and artists use translucent fabrics such as organza, as they can be combined and layered to generate new colors on site. Cubic Prism by Akane Moriyama is made of three different colors of polyester fabric to create a rectangular textile object (fig. 430). According to the viewed direction, multiple color combinations emerge. Colorful, translucent fabrics brighten up spaces in Hiroshi Sugito's collaboration with architect Jun Aoki (fig. 431). Sugito also creates drawings that illustrate space defined by textile-like colored elements (fig. 432). Furthermore, thin textiles can be faintly colored, seeming as if the air itself has been tinted, seen in Yuki Fujisawa's work (fig. 433). Neither static elements nor textiles actually define Do Ho Suh's works; soft colors determine the outlines of everyday objects and buildings (fig. 434, previous page). The reflectivity of textiles can create entire rooms of color, such as the Gala Event design by Gisela Stromeier Design (fig. 435). The name of the work Chroma Passage by Janice Arnold also explains how color is an essential element in textiles (fig. 436).

When observing the wider realm of textiles, there are many abstract works that highlight the power of colors.



RED AND BLUE LINE, Nagoya City Art Museum, Japan
SPIDERS (Jun Aoki, Hiroshi Sugito)
2013



the cane
Hiroshi Sugito
2009
Acrylic and pigment on canvas



flowered
Yuki Fujisawa
2012
Polyester tulle

Fig.433

Gala Event, Whitney Museum, New York, USA
Gisela Stromeyer Design
1999
White spandex soaked in magenta-colored light



Fig.435



Fig.436

Chroma Passage, Grand Rapids Art Museum, Michigan, USA
Janice Arnold (JA Felt)
2010
Felt



Fig. 437

Victorian in Attitude, Edinburgh, Scotland
Aurora Passero
2012
Hand dyed nylon



Fig. 438

Plexus 3, Guerilla Arts, USA
Gabriel Dawe
2010
Polyester thread installation



Fig. 439

O Bicho SusPenso na Paisagem, Estação Leopoldina, Rio de Janeiro, Brazil
Ernesto Neto
2012

Works by Aurora Passero and Gabriel Dawe generate atmospheres by combining textile colors with light (fig. 437, fig. 438). Ernesto Neto's colorful nets are installations that can actually be experienced from inside (fig. 439).

Ptolemy Mann often works with colors in architectural scale. For example, to re-clad St Thomas Hospital, she combined multiple colors depending on the facades' orientation (fig. 440).

Textile colors can be manipulated in great detail to create "illusions" as well. The phenomenon of a disappearing white linen yarn inspired Kristiina Wiherheimo; when colored in black, you could no longer distinguish it in a black space. This led to a curtain design with a floating line pattern (fig. 441).

Many of the examples above may be pleasant and appealing, but do not yet have certain aims to improve our lives. Colors can be both soothing and energizing, and careful coordination can lead to spaces with therapeutic properties. Besides architects, textile designers could collaborate more with doctors or psychiatrists to further improve spaces for those in need.



Fig. 440

St Thomas Hospital, London, England
Ptolemy Mann, David Morley Architects
2010
Building facades



Fig. 441

Roller Blind LASER STITCH R
Creation Baumann, Kristiina Wiherheimo
Trevira CS

3.2.6 Textures and Structures

Basics of Textures and Structures

Every textile has its own structure and texture. Textile structures are often miniscule and are not visible until one looks closely, but they certainly affect how it looks from afar. Textiles with rich or unexpected textures captivate the viewer. Together with the factor of color, textures are what attracts or repels us humans to a certain object. Through tactile experiences and haptic responses, humans experience architecture and environments in general. Some designers are interested in utilizing intriguing structures and textures to add contrast to a given space.

Specifically, the tactile characteristic of a textile structure is termed the hand or handle (Yeager and Teter-Justice 2000, p.47). Besides the smoothness or roughness of a textile, factors such as perceived temperature also affect the hand. A textile may feel warm when the cross sections are irregular and more three-dimensional, while round cross sections and straight fibers may feel cold and slick (ibid.). In addition, same materials can articulate different hands depending on the structure, such as the smooth structure of the satin weave. Woven and knitted textiles have different haptic qualities as well.

Structures are especially important in woven textiles. Textile artist Outi Martikainen refers to textile structures when comparing textiles and architecture. She states that textiles and architecture both have a “layer on top of each other” and “has two systems, one is supporting and one if filling” (Martikainen 2014). As architectural structures need to be understood to build stable buildings, textile structures need to be studied to design suitable textiles for its planned use. Furthermore, it must not be forgotten that textile structures are not invariably stable. Yarns often relax over time, and change tensions after being taken off the loom, leading to shrinkage.

Textures can be altered with different finishes as well. For example, a flocked finish applies fine particles to a textile surface to create a pile effect (Nielson 2007, p.103) (fig. 442). A napped finish also creates a fuzzy look that is similar to a short pile (ibid.). On the other hand, a French wax finish would achieve the glossiest surface, and resin finishes would also produce a glazed surface when calendared. Felting is done by treating a fabric to moisture, heat and pressure, which causes the yarn to shrink into a stable state (ibid., p.108).



Fig.442



Casa da Música, Porto, Portugal

OMA, Inside Outside

1999-2005

White voile knotting, layered with black absorbent projection screen and blackout and acoustic absorbent curtain

Fig.443

Examples, Details and Possibilities

Both textile designers and architects have pushed the boundaries of textile structures, combining both manual work and high-tech processes.

New materials are not always a necessity for innovation, and ordinary materials have been manipulated and transformed into unique solutions as well. The knotted curtain of Casa da Música by Inside Outside was made possible by crocheting voile into large-scale fishing nets, creating a unique openness that would not be possible with a machine-woven textile (fig. 443, fig. 444, next page). Jongeriuslab design studio's curtains for the UN North Delegates' Lounge is also based on a knotted net structure, but is combined with solid elements of porcelain (fig. 445). Maiju Ahlgren's installation consists of a textural textile, made by reassembling torn pieces, that is tempting to touch (fig. 446). In Peter Collingwood's work, ordinary yarns are positioned in precise angles, creating a lightweight but powerful sculpture (fig. 447). Traditional materials are combined with laser cutting in Hugh Scott-Douglas' linen panels (fig. 448). Laser cutting may be further utilized in the future to create various degrees of openness depending on the site.

On the other hand, materials define the structural scale and haptic qualities of the following examples. DUS Architects created a knitted chapel out of ventilation pipes, creating an unexpected bright space inside (fig. 449, next page). Sue Lawty has even managed to weave together lead (fig. 450).

Textures and touch are the main focus in the following spatial examples. Inside Outside designed curtains with a "brush wall," created with a packed surface of fringes that would improve the room's acoustics. Slow furl is a research project by CITA, which experimented with a responsive textile system that slowly reacts to human movement (fig. 451). Relationships between tactile materials and human touch could be further researched, thus resulting in spaces that are more interactive.

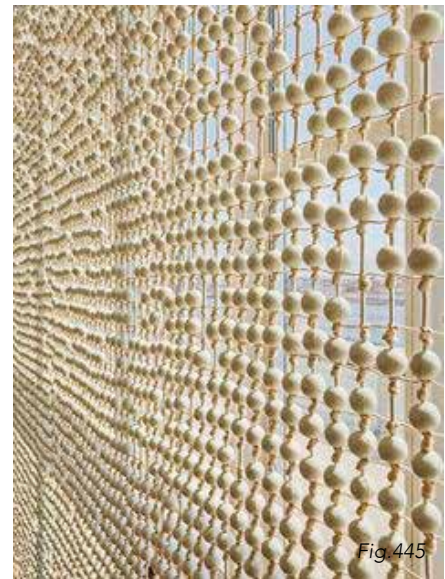


Fig.445

United Nations North Delegates' Lounge,

New York, USA

Jongeriuslab design studio

2013

Hand-knotted yarn, porcelain beads

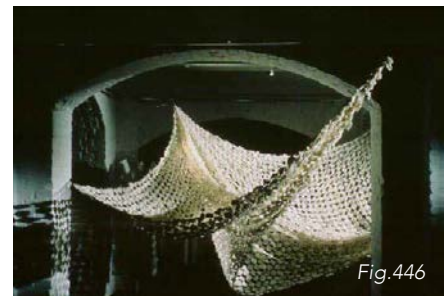


Fig.446

"Life has opened up new horizons,"

Helsinki Design Museum, Finland

Maiju Ahlgren

1999



Fig.447

Macrogauze 3D

Peter Collingwood

Natural and black linen, steel rods

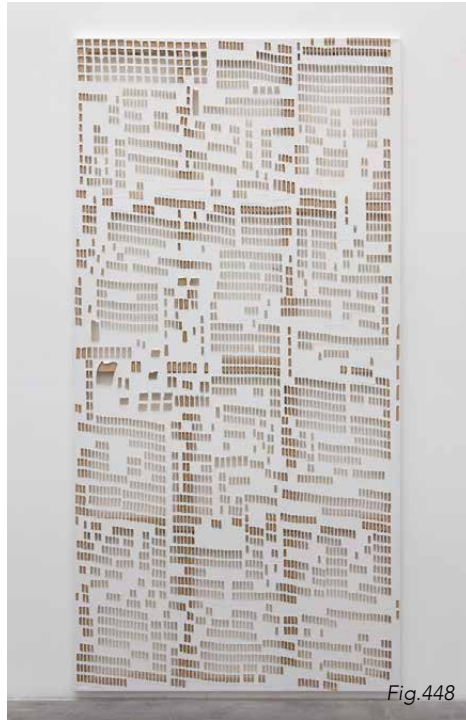


Fig.448

Torn Cheque

Hugh Scott-Douglas

2013

Laser cut linen



Fig.450

Lead weave

Sue Lawty

Lead

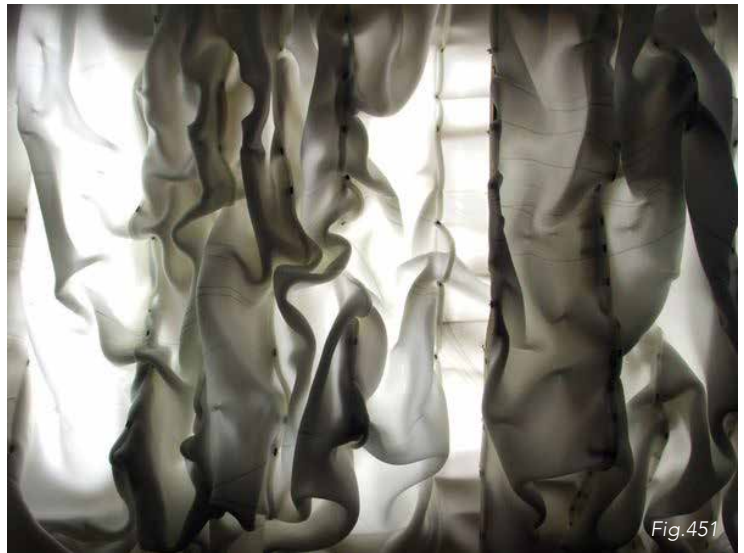


Fig.451

Slow furl

CITA, Ramsgard Thomsen & Bech
2008

Conductive fiber embroidered

Sala 1 - view filter 1a
The blackout goes down;
the view filter follows.

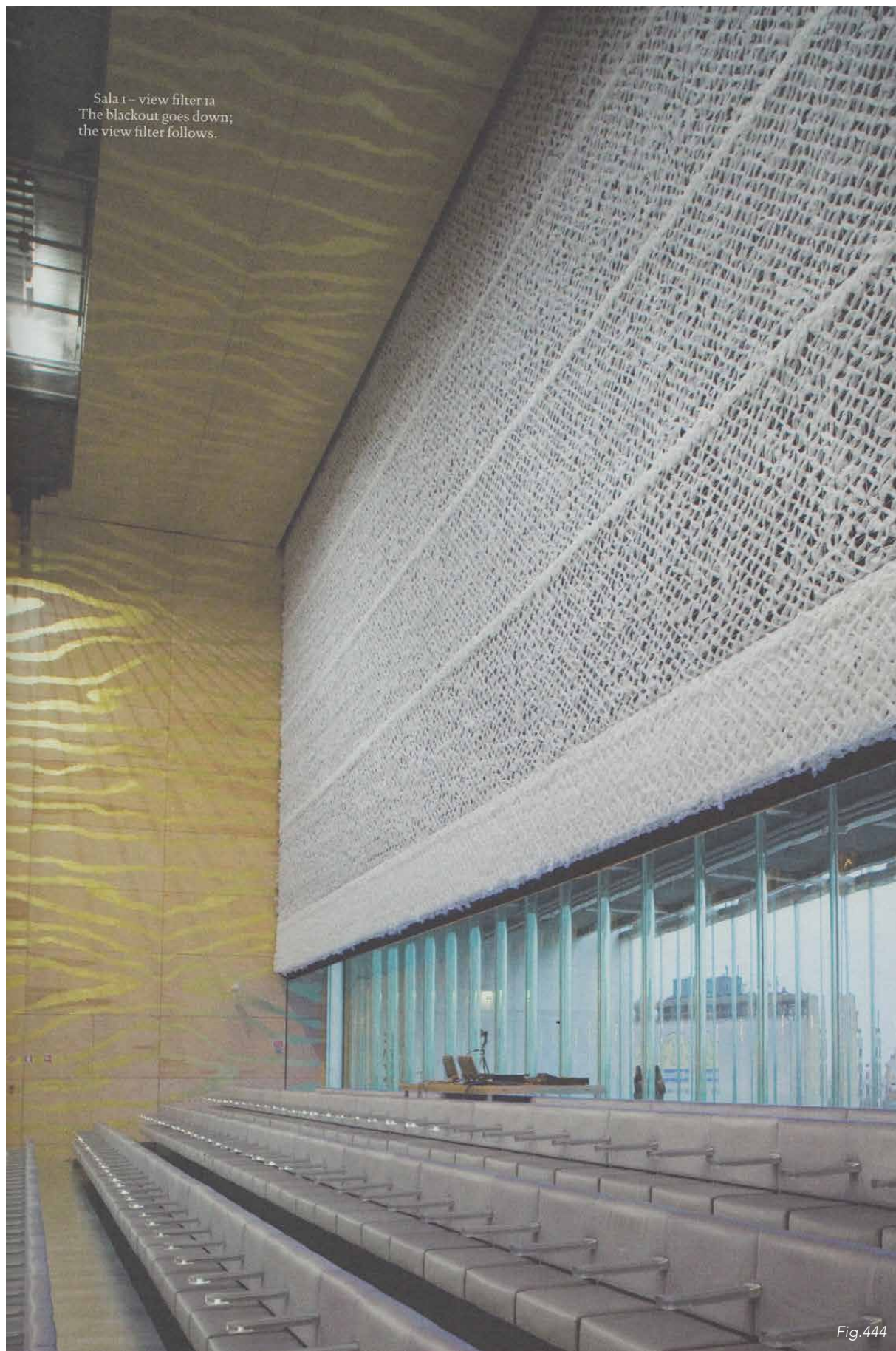


Fig.444



Fig.449

Wedding Chapel, The Hague, Netherlands
 DUS Architects
 2009
 Ventilation pipes

Casa da Música, Porto, Portugal

OMA, Inside Outside

1999-2005

White voile knotting, layered with black absorbent projection screen and blackout and acoustic absorbent curtain

3.2.7 Architectural Concept

Basics of Architectural Concepts

Most likely, architects and other spatial designers have a strong vision of what their architecture or space aims to achieve. Whether it is to revitalize the community, inherit a local tradition, or to become a new iconic building, that architectural concept is the foundation throughout the entire design process. This was also apparent when the idea of a *Gesamtkunstwerk*, or the creation of a “total work of art,” was common. An overall concept would permeate through the exterior, interior, and details of a building. However, after standardization became a common practice, and numerous design options became available to anyone, textiles were less and less related to the architectural concept, thus not integrated into the architecture.

Recently, to further improve the aesthetic and atmospheric aspects of architectural space, several architects and designers have again applied their concepts into smaller details, such as textiles and other interior elements. This integration can also be taken advantage of the other way around; by altering certain elements to contradict with the entire concept, one can highlight or differentiate spaces that need special attention.

Architectural concepts can be derived from various aspects. One way is to gather as much information about the site as possible, such as the history, climate and lighting conditions, and to create a building that would naturally fit into its surroundings. Another emphasis could be to design according to the actions and movements you want to induce inside or around the architecture. Some concepts may seem too abstract and are therefore mysterious to the end-users. Designer Petra Blaisse also asserts that her works “don’t necessarily translate [the researched] knowledge into something recognizable in the end” (Blaisse 2007, p.321). Generally, people are satisfied if a building is comfortable

and it functions properly, and concepts might not matter a bit. However, I believe it is important for the project leaders, which are often architects, to strongly maintain this ambition, as it will lead to innovations in the other related fields as well. It is normal that the initial proposals of architects are not precise in every detail, and only when it is decided that the project will be realized, the collaborative design process will begin. Architect Mikko Summanen also admits that “there are million problems to be solved” at an early stage, but of course, without any problem, nothing novel will be created in the end (2014).

Therefore, it is essential for various experts to join the projects to achieve these architects’ visions. Architects must convey their goal clearly to the professionals who have the knowledge of different solutions and applications. For example, creative director Päivi Grönqvist states that “[she gives] the tools and [she is] the one who is carrying the responsibility that someone can really do it in the end, so that you just don’t think that ... and it’s impossible” (Grönqvist 2014). Her role is not to restrict the possibilities, but is more to work closely with the architect to develop innovative solutions. Grönqvist also prefers collaborations to start from an early stage, because in that way the “textile is never ending up to be a decoration,” but more integrated into the architecture (ibid.). Textile artist Irma Kukkasjärvi has also worked with various architectural projects, and quotes:

Architects say that it is a wonderful feeling to see a building grow from the foundation. That’s how I feel, too, and it makes one do one’s utmost. Sometimes even the foundation hasn’t been dug and there are only the plans and drawings.

- Irma Kukkasjärvi, *Textile Art in Finland*, p.95

However, it is still often understood by architects that textile artists and designers are “working with their



Fig.452

School in Sipoo, Finland
K2S Architects, Vallila Interior
2005-2007

unique pieces of textile which is kind of [a] different world” (Summanen 2014). On the other hand, textile designers may feel that their work is not appreciated by architects and would prefer to work in a limited field. However, there will probably be more and more designers who are interested in collaborations, and as architect Mikko Summanen states, “it would be really good because ... both fields would benefit” (2014). Collaboration is of growing importance in the design field, as it is necessary to join forces to tackle the complex problems of today. This may be too overwhelming a task to accomplish only with architects and textile designers, but there still are greater chances of proposing new and effective architectural solutions through a collaborative process.

Another benefit from collaboration would be the inspiration that architectural concepts could have on textile design. It is common for textile designers to reference many different structures and textures, ranging from molecular scale, human scale to perhaps a galaxy scale. Various structures and patterns seen in architecture can also lead to new ideas in textiles. Textile artist Irma Kukkasjärvi states that in her collaborations, “[t]he starting point of the work is the architecture and atmosphere of the house itself. The content of a work of art will often emerge from its framework... It is from there that the work will progress” (Kukkasjärvi, qtd. in Poutasuo 2001, p.95). Another Finnish textile artist Maija Lavonen also points out the benefits of site-specific textiles:

...the art of textiles is applied art, for it is created with a certain space in mind. ... The textile will only benefit from it. It is better to proceed in this manner than to buy a ready-made work that doesn't fit naturally in the space concerned.

- Maija Lavonen, *Textile art in Finland*, p.95

On the other hand, there are architects who design

their architecture based on a textile-related concept. Woven facades, knitted walls and knotted passageways could create intriguing spatial experiences that people have never experienced before. Textile metaphors are becoming easier to realize with advanced computer software.

Examples, Details and Possibilities

1. *Textiles in relation to glass facades*

Facades are one of the most important elements in architecture. They are not only the “faces” of buildings, but are also the primary boundary between inside and outside. This becomes most vague when facades are made of glass, when the boundary becomes less distinct. Therefore, additional curtains may disrupt the fluid relationship of the interior and exterior. To avoid this, some designers and architects have succeeded in installing textiles that merge and even enhance the transparency of glass. Some related examples were explored in Chapter 3.1.1 (p.104). K2S Architects designed special curtains in collaboration with Vallila Interior for a school in Sipoo, Finland, where “the proportions and the texture and the color ... are very important to the whole composition of the façade” (Summanen 2014). Monotonous glass windows are livelier due to the mobile shades in two shades of green, which colors are further intensified when layered (fig. 452).



KMC Corporate Office
RMA Architects
2012
Hydroponic garden veil



François Pinault Foundation for Contemporary Art,
Boulogne-Billancourt, France
Dominique Perrault
2001
Metal Mesh

2. *Textile-like facades and structures*

Instead of combining glass facades with textiles, there are actually many architects who substitute glass with materials that also allow light through, like textiles. These examples are not actually spatial textiles, but demonstrate the diversity of applications that textile thinking has brought about. The term “curtain” can now relate to textiles, glass, wood, metal, and even light. As architect Mikko Summanen suggests, the “gesture of a curtain” is often discussed in architectural design (2014).

For example, the KMC Corporate Office by RMA Architects adds an additional façade consisting of a plant veil (fig. 453). The plants not only regulate light like a textile curtain, but also “bring the lowest caste of employee – the gardeners – into the heart of the architecture” (“Blurred Lines: The UIA Congress in Durban, South Africa”). Metal meshes also have openness factors similar to netted textiles, and can envelop entire building environments (fig. 454). As explained in Chapter 3.1.1, architect Dominique Perrault developed metal fabrics in collaboration with a German manufacturer GDK. Perrault uses meshes also in the interior, resulting in a “metaphysical landscape” (Drew 2008, p.34). Furthermore, bricks create a woven pattern, regulating strong light in the Hotel Paasitorni (fig. 455). The brick pattern merges with the solid brick wall, resulting in a smooth transition. Graphic Concrete produces concrete surfaces with various textures and textile-like patterns, improving the tactility of the cold material (fig. 456). The ultimate “textile-like curtain wall” may be the finalist entry of the Helsinki Guggenheim Competition (fig. 457). Here, stiff materials are permanently shaped into a pleat pattern, whereas the architects refer to the building as a “quiet animal” and the façade as a “pet’s fur.” Undulating glass structures are also seen in the Peek & Cloppenburg in Berlin and Landschaftspark in Darmstadt, Germany (fig. 458, fig.



Hotel Paasitorni
K2S Architects
2012
Brick

Ospedale Giovanni XXIII, Chapel
 Traversi + Traversi Architetti, Stefano Arienti
 (design/graphics of concrete), Graphic Concrete
 2012
 GC-ArtDesign™ (Concrete)



Fig.456



Fig.457

Helsinki Guggenheim Competition Proposal
 2014
 Thermo-formed glazing panels



Fig.458

Peek & Cloppenburg, Berlin, Germany
 Gottfried Böhm
 1995
 Glass



Fig.459

Landschaftspark, Darmstadt, Germany
 Planinghaus Architekten
 2003
 Glass

Centre Pompidou-Metz, France
 Shigeru Ban Architects, Arup AGU,
 Taiyo Europe (roof membrane)
 2005-2010
 Teflon-coated fiberglass membrane



Fig.460

459). These projects still show the structures of the glass, whereas the Guggenheim proposal aims to eliminate all other materials from the overall look, resulting in a “tablecloth” building.

Besides facades, other architectonic elements can resemble textiles. Shigeru Ban’s Centre Pompidou-Metz has a curved roof, which woven wooden structures are visible through the fiberglass membrane (fig. 460).

A shape of a certain textile can be enlarged into architectural scale as well. This idea is conveyed through Y-Knot proposed by Mark Garcia and Jonathan Goslan (fig. 461). Although not realized, this proposal demonstrates how even the smallest structures can become an inspiration for architectural space.

A radical research titled Transformer by The Why Factory looked into the possibilities of space that would be generated and altered by humans, on the spot (fig. 462). Textiles and architecture that are flexible to that degree has not been realized, but nevertheless, soft, interactive boundaries are eagerly anticipated and researched.

Hopefully, actual textile materials will also be used in facades, and more preferably, the facades should accommodate old and used textiles, giving them a second life.



Fig.461

Y-Knot (proposal)
 Mark Garcia + Jonathan Goslan
 2006
 Steel beams, glass, metal panels



Fig.462

Transformer
 The Why Factory (MVRDV, Delft University of Technology)



Fig.463

Villa Edstrand, Falsterbo, Sweden
Sigurd Lewerentz
1935-1937



Fig.464

Verkatehdas Arts and Conference Centre,
Hämeenlinna, Finland
JKMM Architects
2004-2007

3. *Textile-based interior elements*

Textiles have also been used in small-scale areas within architectural space. Upholstery fabrics and rugs are also smaller textile elements in interiors, but the following examples present more spatial and innovative solutions.

For example, architect Sigurd Lewerentz designed stairs with only a textile and a thin, steel-like structure (fig. 463). The lightness of textile material contradicts with an architectonic element that should be very stable, resulting in a unique combination.

Furniture, textile and architecture become one in the sofas in Seinäjoki City Library by JKMM Architects, introduced in p.122. In JKMM Architects' works, there are often textile elements that are truly attached and integrated into interior surfaces (fig. 464). This demonstrates that textiles are regarded from an early stage in the design process, and are not additional. Interior architect Tiina Rytönen of JKMM Architects states that textiles can be "more like [an] architectural element also," and to become a "kind of wall structure" (Rytönen 2014).

However, not all textiles need to be implemented from an early stage to be related to the architectural concept. In site-specific artworks, inspirations are often derived from the surrounding environment and site context. Textile artist Maija Lavonen created a textile for the Varkaus Municipal Library where she "sought to capture the mood of the city and its milieu" (Lavonen, qtd. in Poutasuo 2001, p.99).

Perhaps other architectural details such as doors, door handles, shelves and closets could be constructed with textiles. If stairs were possible, why not floors and ceilings as well? Textiles would be ideal for those objects that we regularly touch. By using contract textiles that withstand strict regulations, these haptic elements would be able to endure heavy usage.

4 Summary

Our present day living environment seems very complex. Dense cities, the aging population, rapid economy, population growth, continuous poverty, war, and environmental problems – even a single one of these phenomena is impossible to explain in one go. Issues and problems are perplexedly intertwined, and even a small act could affect large numbers of people on the opposite side of the world. We should act responsibly, or at least have in mind of the consequences that may result from the slightest change in a decision. I believe the role of design and consciously designed spaces is to nudge these decisions or people's ideas towards a different direction, preferably positively, sometimes negatively if necessary.

Over time, there has been various approaches towards design. Long ago, it was not about “design” or such discipline; it was solely about solutions for the fundamental needs of humans. Before there was a clear distinction between the home, clothing and tool, what surrounded human beings was an extension of the human body. We wrapped ourselves in animal hides and plant fibers, or retreated into natural caves – whatever was in our surroundings, which would fulfill our fundamental needs to live safely and warmly. Therefore, architecture was textile, and vice versa; textiles were architecture. In primitive settings, humans probably did not have much choice to consider if something was beautiful and suited their taste. What functioned was valued. Lightness and portability was also essential, as humans needed to move regularly to gather food and new materials. Later on, this was less a necessity, and more durable and stiff materials were preferred in shelters. Thick or layered walls protected humans from both natural phenomena and man-made disturbance. However, the pliability of textiles still had important roles, to insulate and to divide these stiff spaces. Buildings could not be moved, but textiles constantly travelled with humans. The above roles of textiles in architectural space, up until the Middle Ages, are still applicable – and should be reconsidered – in current society.

After this point in history, architectural space started to be designed in less relation to functionality. Different styles and decoration illustrated wealth and hierarchy. Some people had access to exotic materials and techniques, and the new meanings of luxury affected less affluent lifestyles

as well. Of course, new materials and abundant layering also had its technical functions besides portraying wealth and “good” taste. These spatial textiles are still an inspiration; as such abundance was lost with the emergence of modernization. However, it can be affirmed that the relationship between textile, human and architecture was less substantial during this period.

The Modern Movement drastically changed our environment. Architectural design became an established profession, and architects were eager to propose new design solutions. Generally, there were less soft materials in architectural space, for both hygienic and conceptual reasons. When textiles were used, architects preferred as little decoration as possible. This is still the case in many buildings; textiles that do not interfere with the overall design are favored. Petra Blaisse of Inside Outside states that “[i]t is always a delicate balance: solving too many issues with textile – making them too present – could work against the stark, structural character of the building” (Blaisse 2007, p.368). Thus it is often the case that the visual aspects of textiles are mostly determining which one is used over another. When this happens, textiles are somewhat related to humans and architecture, but only to a superficial degree. Textile designer and creative director Maarit Salolainen also affirms that textiles and architecture have been separated for many years (Salolainen 2015). In addition, tensile structures do integrate textile and architecture, but they are often not designed in relation to the smaller human scale.

Luckily, there is now a gradual movement towards change. First, technological advances have given architecture and textiles additional traits that are more human centric. Computer generated designs are less oriented towards visual innovation, but more towards the human experience and activity. Humans could further interact with architecture and textiles in the future, so as to enhance our living environment. Second, material-based

design is becoming more and more important. As Maarit Salolainen points out, it is already an important factor in fashion design, and she believes textiles will also become more centric in architectural design, bringing the two fields together again (2015). Third, sustainability is one of the most discussed topics nowadays. In any field of design, it is an ongoing priority to waste less and to only produce objects or ideas that are sustainable and truly necessary.

This change is still ongoing, and designers in multiple fields are encountering many challenges, trying to enhance the living environment by using as few resources as possible. I strongly believe that spatial textiles can play a significant role in this change. This is because they have met our fundamental needs for hundreds of years, and now possess even more roles due to recent developments. By combining insights old and new, textiles have the potential to reconnect architecture and humans. By delicately designing this triangular relationship, not only the building itself, but its inhabitants and surroundings can be nudged and enhanced. Furthermore, I believe in the possibilities of textiles over other materials and elements due to their softness, lightness and tactility. These inherent characteristics are seen nowhere else, and the infinite variety of materials further diversifies the range of solutions that could be possible. Below is a quote by artist Kristiina Wiherheimo. Textiles can generate vague and delicate feelings and emotions in architecture, whereas hard materials are more difficult to relate to.

What can only textiles do in architectural space? ...

It is of course the feeling, the feeling of...the emotions.

- Kristiina Wiherheimo, 2015

So what exactly are the most pressing issues and promising intervention points for spatial textiles? Through my reflections on the expert interviews and readings, I believe the following topics are most urgent.

- ***Energy conservation***

One of the most direct actions we can take towards a more sustainable future is to use less energy and resources. Efficiency in new buildings has improved, and people are more conscious than before to save energy, but generally it is still difficult for normal households to limit their usage without compensating their comfort. In areas of current development, it is essential to initially input sustainable systems to benefit in the long run.

Despite this need for better-insulated buildings, glass facades are growing in numbers, especially in the city. In warmer climates, glass allows a great amount of daylight inside, and interiors are easily heated up. However, normal curtains would interfere with the entire concept of a glass building – its transparency.

Overall, I believe that innovative curtains that are both highly functional and aesthetically appealing need to be developed. Besides shading off strong light, curtains that are site-specific can give character to monotonous glass facades. There are existing solutions for small-scale projects, but their designs are usually not suitable for large surfaces. In Chapter 5, I have looked further into this issue to propose a large-scale curtain for the glass façade of Helsinki Music Centre.

- ***Creating flexible spaces within spaces***

Workspaces are in need of transformation, one after the other – this is the strong impression I received from many expert interviews. Architects and interior architects are struggling to meet the many requirements that their clients demand, including acoustics, privacy, flexibility and openness, all at the same time. Currently, it is more common for people to not stay at one desk the entire day, and spaces need to evolve to accommodate relaxed talks as well as confidential meetings within a restricted area. Contradicting wishes seem impossible to fulfill within one site, but there may be optimal solutions by installing

spatial textiles. Textile materials have all the necessary properties, and with the correct combinations, intimate spaces within an open space could be realized. Further ideas will be explored in Chapter 5, incorporating my internship experience at Studio Samira Boon.

- ***Renovation and revitalization***

Structures of existing buildings are durable than before, and do not need to be taken down when their interiors have stopped functioning. This leads to an increase in renovation projects, which now dominate a large amount of work in the architectural field.

There are various ways to renovate an old building. One could simply restore the old elements to its original state, or a completely new design could be implemented, without any reference to its old state. A subtle but popular take is to preserve the original interiors to some extent, while adding an entirely new function. This conversion method revitalizes existing spaces, and is often less costly than perfect restoration or total renovation.

Furthermore, spatial textiles can revitalize existing spaces. Revitalizing takes renovation or conversion one step further; it means that the space has evolved to lure people into the atmosphere, and to stimulate happenings and encounters that will disperse the activity outside the building as well.

Creative director Päivi Grönqvist also states that textiles specify the time more than the architecture itself (2014). Spatial textiles can highlight certain moments or functions, depending on the way it is designed and implemented. Ultimately, an enhanced and carefully designed space will also be respected and frequently used, leading to its longevity within the urban tissue. My long-term goal is to design spaces and textiles that have a revitalizing function.

Taking the above issues into account, I will finally propose several spatial textile ideas in Chapter 5.

5 Proposals

Finally, I will answer the following research question by proposing several design ideas related to each of the topics discussed in Chapter 4:

How can textiles be designed and implemented in a way that enhances architectural space and creates interesting relationships between textile – human – architecture?

As explored in Chapter 3, spatial textiles possess numerous roles that can positively affect architectural space. However, a combination of all functions into one textile is not possible, nor is it necessary. The number of roles a textile has does not directly relate to the achieved enhancement of an architectural space. In some cases, one outstanding function may be better than several moderate functions.

Therefore, when designing textiles for an architectural space, one should first carefully examine the planned site for its current properties, both good and bad. Good properties can be combined with textiles and utilized. Bad properties may be adjusted with the textile intervention. Thus, the building – or even an outdoor site – determines what roles are needed.

Secondly, based on the site study, one should consider what an “enhanced” space would be like. Is it a space that is inviting and lively with lots of human activity, or is it a space with a soothing atmosphere that assures the user’s safety and privacy? The pursued effect should determine the many decisions that will be made during the design process. This should especially help determine the aesthetic and atmospheric roles, so as not to make decisions out of mere personal preference.

However, two problems arise with this site-specific

design process. First, the roles cannot be selected if there is no particular site. This is not an exceptional case, and textile elements are often designed for implementation in various settings. The function of the planned context, i.e. working, studying, shopping or production, may be fixed, but further details about the surrounding environment, the building itself, lighting and other elements, are not known. Second, there are projects when textile designers collaborate with architects from a very early stage. In this case, there is no ready-made building to examine the properties, and the textile designer has more freedom to present more ideas of her or his own.

To overcome this dilemma, two other design processes will be explored below in comparison with an ordinary site-specific approach. The first alternative design approach is based on research. This proposal is part of the commissioned project from the TextielLab in Tilburg, the Netherlands, on which I worked during my internship at Studio Samira Boon in Amsterdam. The second alternative approach is similar to an artist’s way of working. Here, I aim to convey a personal mission, utilizing the available materials and techniques.

There is, in fact, no single answer to the initial research question. However, I believe the following approaches demonstrate the variety of possibilities of spatial textiles. By disclosing the processes in detail, I hope the proposals will spark new ideas for designers, architects, and manufacturers alike. In addition, by working with several concepts, I aim to encourage and deepen my own understanding of what an “enhanced” space could be.

5.1 "Valonuotti" (light-note)

– Curtains for Helsinki Music Centre

Site-specific Approach

Background

The **Helsinki Music Centre** is a public building in the center of Helsinki, Finland (fig. 465). It was designed by LPR Architects of Finland and opened in 2011. The building consists of a glass box that envelops several concert halls and a school. The inner structure is especially visible at night, and the people inside become exposed (fig. 466). Furthermore, Finland, being a Nordic country, has extremely short nights in the summer and short days in the winter (fig. 467). Without any curtains, the glass facades – especially the south side – receive strong sunrays during the summer. In addition, an additional textile layer would improve insulation during the cold winter.

As mentioned in Chapter 4, it is crucial to develop innovative solutions for regulating light and airflow in glass buildings without degrading the aesthetic properties of glass. The Music Centre is a suitable example to examine this situation, as there are two sides consisting mostly of glass. The transparency also clearly illustrates the building's notion to provide sufficient views of the surrounding park. Furthermore, the client's goal was to have the building as "open and easily approachable as possible" ("Helsinki Music Centre | LPR-arkkitehti"). Therefore, I chose this site to propose light-regulating curtains that would benefit the architecture, not only functionally but also aesthetically.

Site

Before starting the design process, it is important to look into the site context as much as possible. If a textile designer is appointed during the architectural design phase, she or he should take part in discussions with the client and architect. As a team, they can collaborate and develop concepts, to achieve an integrated design of materials, techniques, structures, landscapes, and social activity. When an issue is found, specialists can propose solutions based on their expertise, and knowledge from different disciplines can be combined to reach an ultimate solution.

However, it is also common that an existing building needs additional properties, and a new phase of design is initiated. This is the case with the Helsinki Music Centre. Although it is not possible to develop ideas through a multidisciplinary discourse at this stage, I will still take a moment to start with the investigation of the site. In fact, it can also be beneficial to reassess the qualities after the building has been erected and used for several years. New and additional findings can be utilized to further extend the lifespan of the architecture.

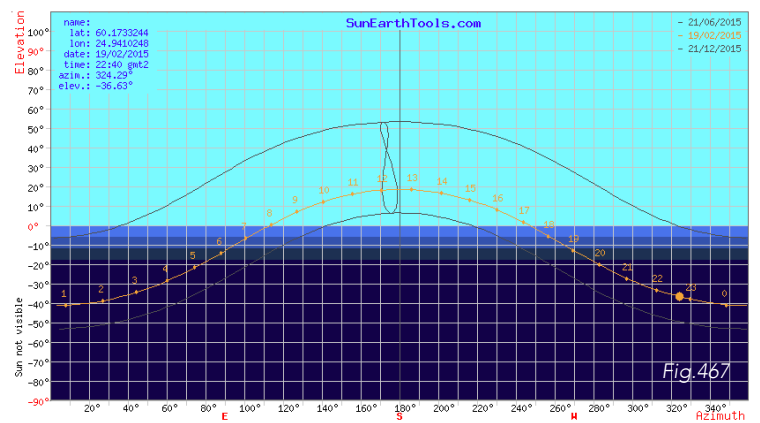
First, general information about the building and function are gathered to form a basic, essential knowledge of the site. The building is mainly occupied by "the Helsinki Philharmonic Orchestra (HKO), the Finnish Radio



Fig.465



Fig.466



From top to bottom, Fig.465 Helsinki Music Centre from the south. / Fig.466 The southern facade. / Fig.467 The sun path of Helsinki at the summer solstice, during February, and the winter solstice.

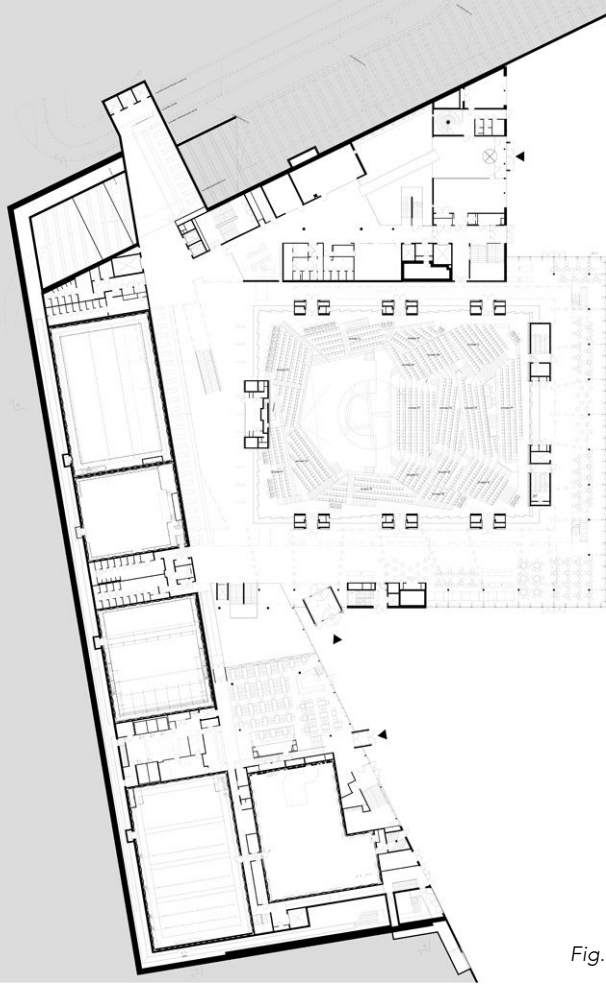


Fig.468

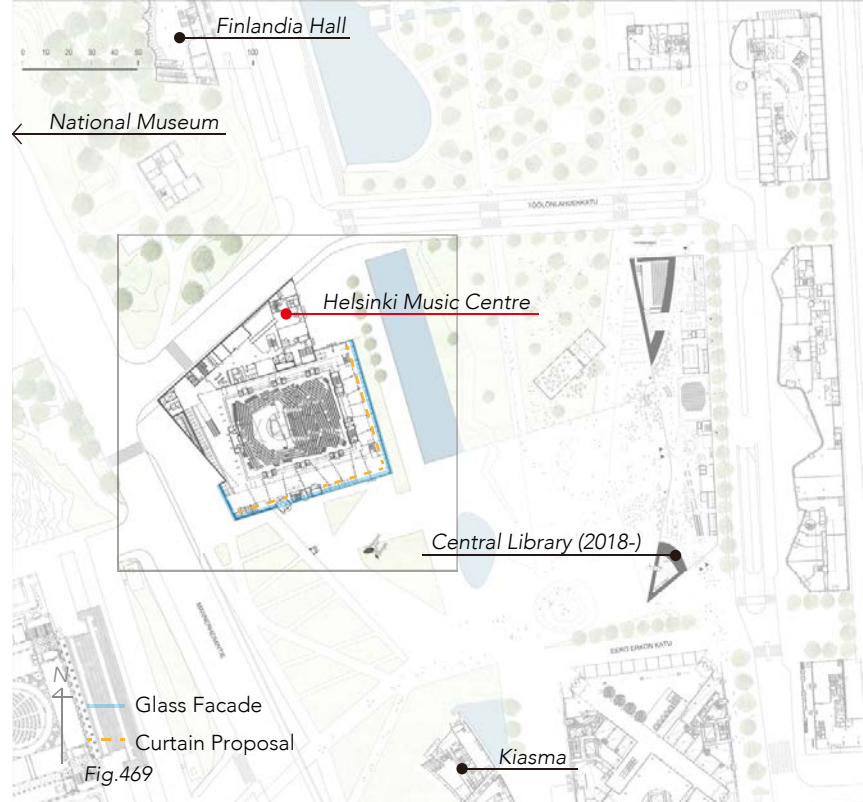


Fig.469

Symphony Orchestra (RSO) and the Sibelius Academy of the University of Arts Helsinki” (“Helsinki Music Centre | LPR-arkkitehdit”). The client was the State of Finland, and the floor area is 38,600 square meters. The key point of the design was that “[a]ll planning as well as architectural and technical solutions were driven by the requirement for the highest possible quality acoustics” (ibid.). Japanese acoustician Yasuhisa Toyota designed the total acoustic scheme. A large concert hall is surrounded by a spacious foyer and lobby. There are six additional, smaller concert halls with various acoustic solutions (fig. 468). The glass façade, which is “suspended and reinforced with glass plates and steel rods, is technologically progressive” (ibid.).

Second, the building’s surroundings are investigated. The Helsinki Music Centre is located to the west of Helsinki Central Railway Station. It is situated within **a rich architectural context**; Saarinen, Gesellius and Lindgren’s National Museum is to the northwest, Alvar Aalto’s Finlandia Hall to the north, Steven Holl’s Kiasma Museum to the south, and the planned new Central Library to the east (fig. 469). Lawns and pathways connect these monumental buildings, and the terrain gradually tilts upwards towards the north. The east façade is entirely glass, and most of the south façade is glass as well. This gestures an opening towards “the Kiasma museum, central library and Sanomatalo building, **linking the Music Centre to the area’s new architecture**” (“Helsinki Music Centre | LPR-arkkitehdit”). It is natural that the building opens up towards the city center and the direction of most visitors; though the older buildings in the north are more or less forgotten. In addition, the area around the Central

Top Left, Fig.468 Building plan showing various concert halls. / Top Right, Fig.469 Site plan. / Right, Fig.470 Sun altitude and hours at the summer and winter solstice.

Railway Station is highly developed in comparison to the rest of Finland. Seventy percent of Finland is covered in forest, but nature is not a priority at this site. The focus is directed more towards the man-made, and all the materials in the area are stiff and unchanging.

Third, the varying lighting conditions are studied, as there is a great difference between summer and winter light. The sun orientation and altitude of the summer and winter solstice are illustrated in Figure 470. The south façade receives direct light throughout the year, but the altitude differs greatly. The altitude also differs in the east façade, but after noon there is no direct light. This actually means sun-regulating curtains are not necessary for the entire year, or the whole day, in the east façade. When there is no sunlight, temperature insulation and nighttime privacy are instead the necessary functions. Therefore, an adjustable curtain with multiple functions is suitable for such glass facades.

Fourth, Finland will celebrate its centennial birthday in 2017. It is worth considering the role of the Helsinki Music Centre for this timely occasion. Could it act more as a central junction in between the many prominent sites? Can a transparent building convey a stronger message towards the future of Helsinki or even all of Finland? Finland currently has a larger presence in both the cultural and business world, with its popular startup events, game applications and design. But what actually does represent modern day Finland and Helsinki? Textiles are more or less ephemeral, and they have the capacity to portray a punctual subject. In this case, the centennial occasion cannot be ignored.

From the above research, several main points to focus were derived (fig. 472, next page). For the Helsinki Music Centre, I decided on two chief functional roles and one sub-functional role. Out of the aesthetic and atmospheric roles, I also chose two main and one sub-role. The selection of multiple roles is deeply related to the site research in order to push the limits of a single fabric.

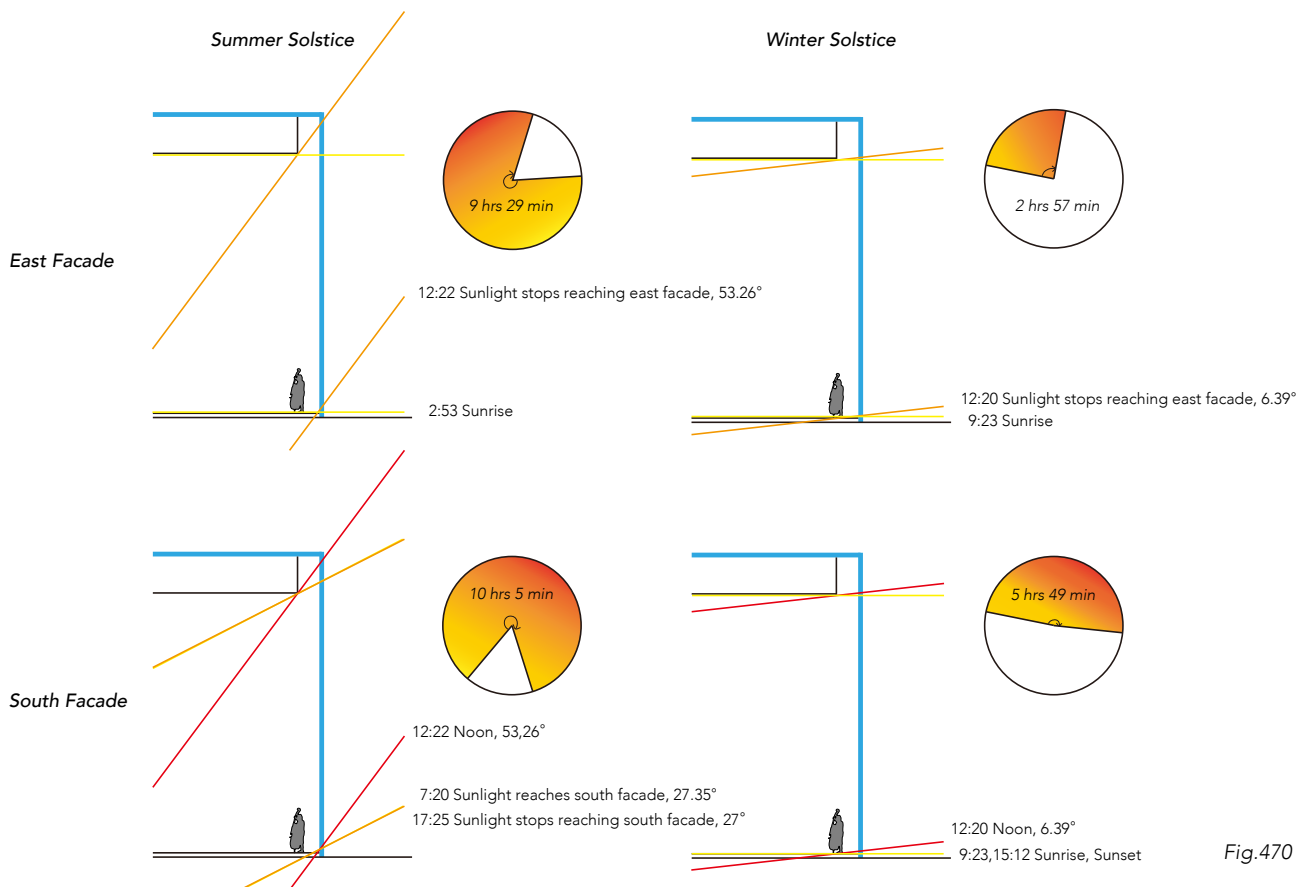


Fig.470

Proposal / "Valonuotti"

Functional and Technical Roles

Appropriate materials and structures that meet the roles below are chosen, and integrated into one long strip of fabric. By rotating the fabric with a gradient of functions, various effects can be achieved (fig. 471, 472, 476).

- Light Control - a
- Temperature Insulation - b
- Acoustic Control - c
- Visual Privacy and Temporary Division - d

Each strip is 16.5 meters long and a 1.65 meters wide, and divided into the following three sections. The sections merge into each other, as the aspect ratio of the yarns are inserted in a gradient (fig. 477, next page).

A. Reflective area (Roles a, d)

This area uses subtle reflective yarn of white-silver color (labelled "R" in fig. 477), woven in a structure that imitates the ripples of a liquid surface.

B. Soft area (a, b, c, d)

This area uses a soft yarn, with a wool feel (labelled "S"). The material qualities absorb sound and trap air. The texture is inspired from the Finnish forest.

C. Transparent area (a)

This area uses transparent materials, and transmits necessary light but softens the strongest rays (labelled "T"). This function is necessary during the winter, when extremely low light penetrates deep into the building, but the warmth of the light is too valuable to be restricted.

Aesthetic and Atmospheric Roles

- Light and Transparency
This is simultaneously considered in the design process above.
- Architectural Concept
 - o Historical inspiration
The Helsinki Music Centre opens its windows towards the city center, but two monumental buildings in the north and west are disregarded. Thus, the unique facade patterns of the northern Finlandia Hall and the western National Museum are given a new life in the proposed curtain (fig. 473). For example, the irregular rhythm of the National Museum granite blocks is repeated in the east facade (fig. 474). When seen from the east side of the Music Center, this gives an impression that one can see through the building. Moreover, these patterns disguise the repetition of the curtain strips.
 - o Interactive "music score"
The above design process mainly considers the relationship between "textile" and "architecture." In order to integrate the human, I added a participatory element in the curtain. Five lines, indicating the lines of a music score, add a subtle texture to the transparent area (C). This is like a blank sheet of paper, where visitors can attach musical notes of their own preference (fig. 475).

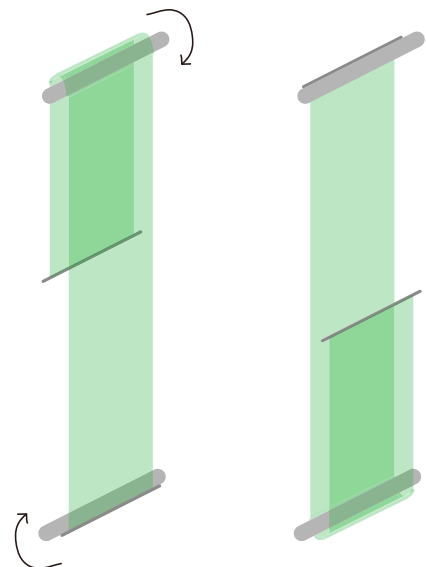
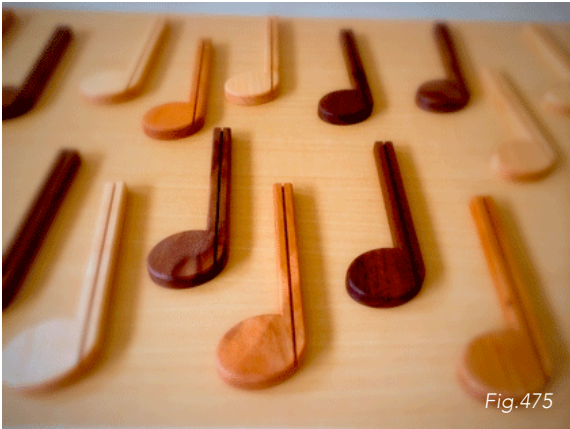
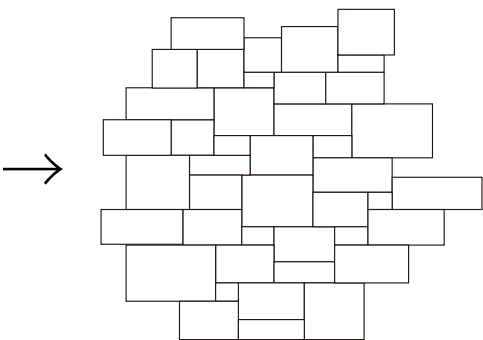
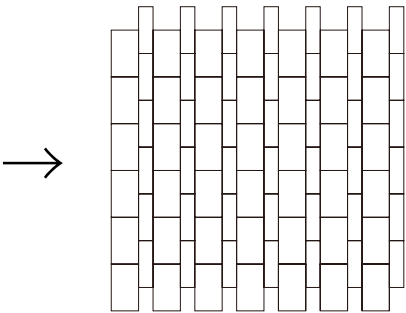


Fig.471

Aim: To design a multipurpose curtain that does not interfere with the glass facade and induces interaction with visitors

		FUNCTIONAL/TECHNICAL ROLES						
		Light Control	Temp. Insulation	Acoustic Control	Vis. Priv. & Temp. Div	Weatherproof	Structure Function	Other Func. Roles
Proposal 1	Valonuotti							
		AESTHETIC/ATMOSPHERIC ROLES						
		Light & Transparency	Sp. Placement & Scale	Pleating & Layering	Way of Movement	Colors	Textures & Structures	Arch. Concept

Fig.472

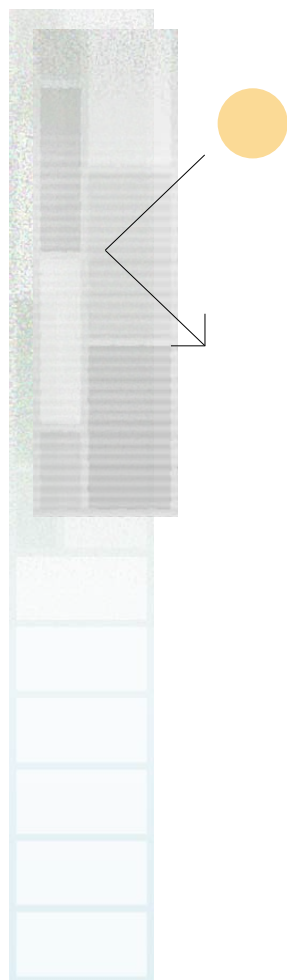


Opposite page, Fig.471 Rotational system of curtain. / Top to bottom, Fig.472 Selected roles. Darker color indicates stronger emphasis. / Fig.473 Finlandia Hall. / Fig.474 National Museum. / Fig.475 Attachable musical notes.

Summer / From interior
Sound absorption



Summer / From exterior
Sunlight reflection



Nighttime / From interior
Light diffusion



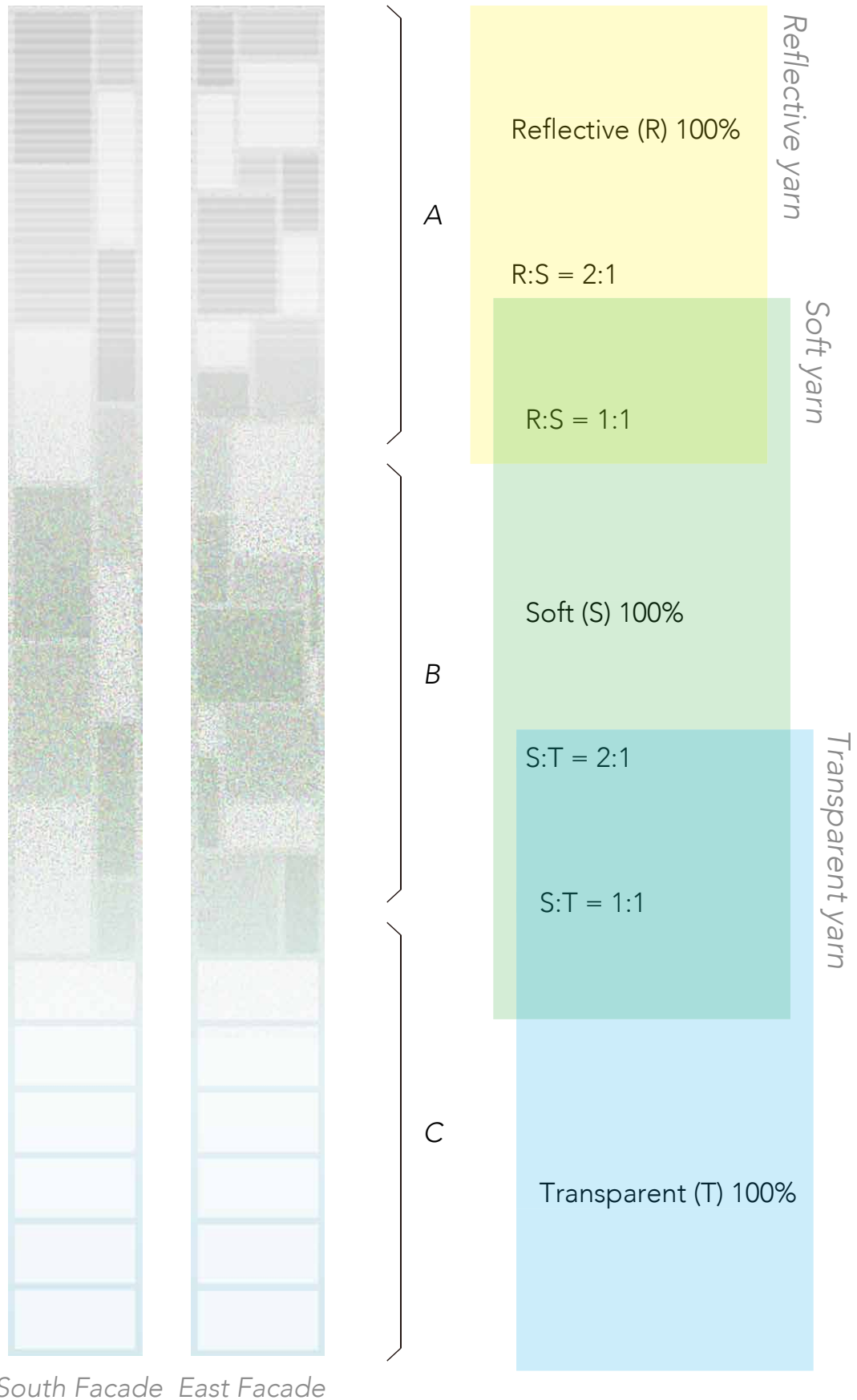
Nighttime / From exterior
Privacy



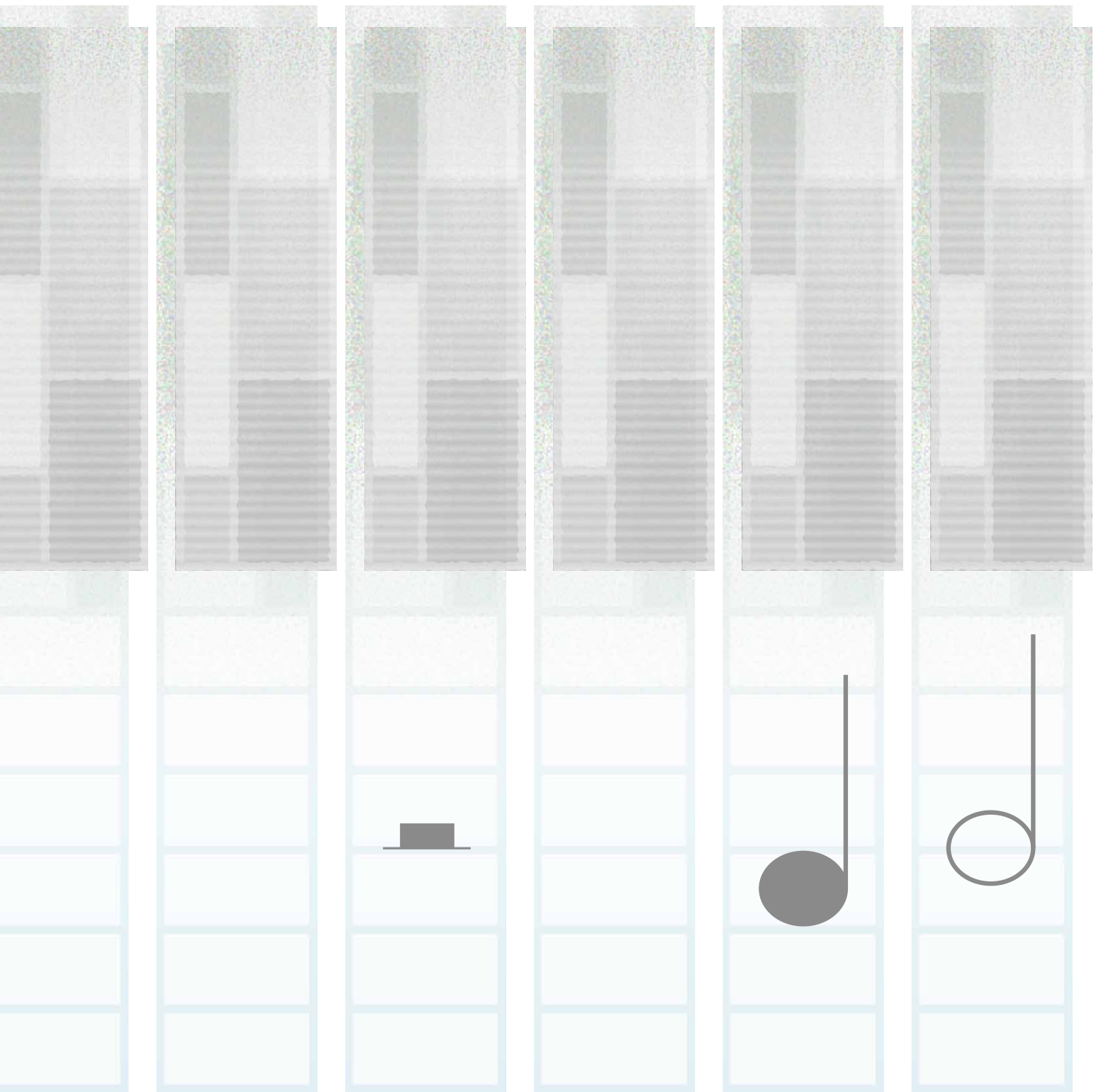
Above, Fig. 476 Several variations of the surfaces of the curtain. / Right, Fig. 477 Ratio of weft yarns.

Warp: Transparent monofil

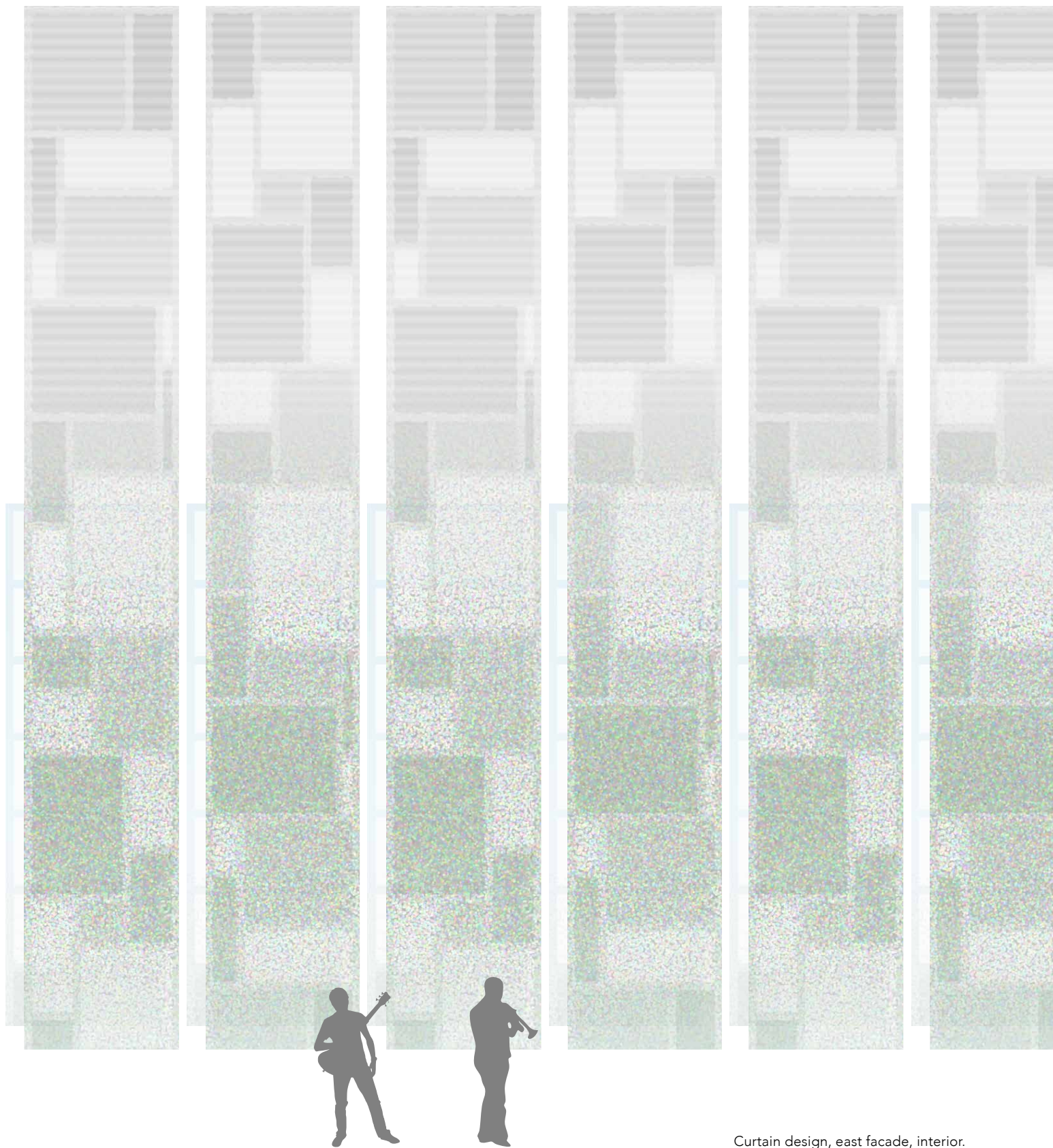
Weft yarn ratios:



South Facade East Facade



Curtain design, south facade, summer exterior.



Curtain design, east facade, interior.



South facade, sun-screening section of the curtain in the upper half of the facade.



Interior facing southeast, south facade with sound-absorbing section in the lower half of the facade.



5.2 "Poly-Pod"

– Foldable Acoustic Partitions

Research-Based Approach

Background

In February 2015, I began an internship at Studio Samira Boon, a design studio in Amsterdam, the Netherlands. Samira Boon focuses on designing functional products and textiles, integrating research and material development. Supervised by Boon, I participated in a research titled "**Super-Folds**," which aims **to develop foldable, woven textiles that can be implemented in architectural scale**. The research is a commissioned project from the TextielLab in Tilburg. The first phase was completed prior to my participation, and presented in the "Building with Textiles" Exhibition in September 2014. The results of the second phase will be presented together with design studio Inside Outside in December 2015. The second phase aims to achieve results that are "ready-to-market" and can be instantly applied in real life situations. Upscaling foldable structures with textiles has been a challenging task, and for the sake of the ongoing research, some details are omitted in this thesis.

Introduction to Research

With a background in architecture, Samira Boon became interested in three-dimensional textiles and their potential in architectural space. She also became fascinated with folding techniques like origami after living in Japan and South Korea for several years. Although folding is most often done with paper, Boon found various advantages of folded textiles. The acoustic regulation, durability, textural variety and flexibility of textiles would increase application possibilities. Furthermore, folding textiles could expand to architectural scale or become compact and easy to store. As textiles could become completely flat when unfolded, Boon believed "it should be possible to weave habitable objects straight out of the [weaving] machine" ("ArchitectuurNL," 2014). Self-folding textiles could "take of itself a form that is even constructive" (ibid.).

Boon's ambition merged together with a collection assignment from the Textile Museum in Tilburg. This assignment titled "Super-Folds" developed along three principles ("Super-Folds"):

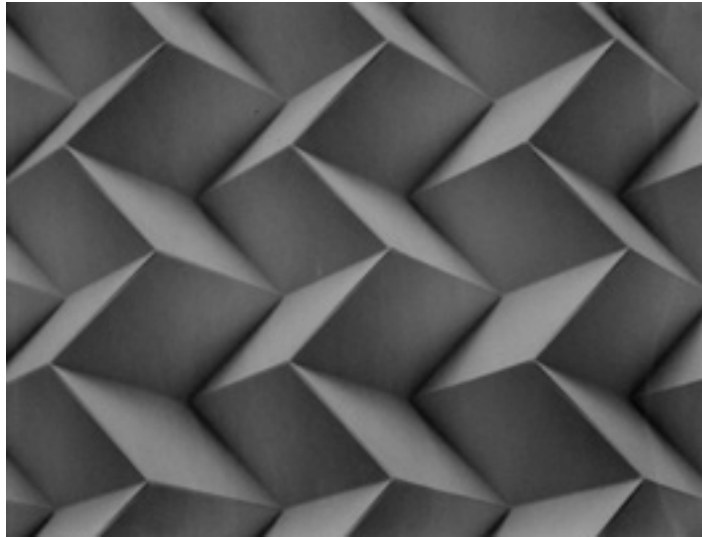


Fig.478 Miura-ori.



Fig.479 Yoshimura pattern.

1. The capability of the computer pre-programmed folding structures in textile
2. Aesthetic and tactile properties of folded textile structures
3. The possibility for deriving structural properties, with the ultimate goal to produce a self-supporting dome directly from the machine

Phase one of the research began with the configuration of the appropriate bindings and yarn material for folding the fabric. Close collaboration with the machine technician and developer/programmer of textiles was key to this development. In order to achieve foldability, the bindings of the creases were designed to have opposite properties on each side: “hard versus soft / rigid versus flexible” (ibid.). This led to unbalanced tensions that were problematic to the loom. Numerous trials and further research led to a precise formula that was both weave-able and foldable.

Next, different folding patterns were examined, based on the *Miura-ori* (ori 折り means fold in Japanese) and the Yoshimura pattern. The *Miura-ori* was developed by a Japanese astrophysicist Koryo Miura, and is “a method of folding a flat surface such as a sheet of paper into a smaller area” (“Miura fold”) (fig. 478). The surface can maintain its rigidness throughout the folding process, thus stiff materials such as solar panel arrays for space satellites can be folded (ibid.). The *Yoshimura* pattern, or the Diamond pattern, was discovered by Yoshimaru Yoshimura, a senior researcher of Miura. This rhythmic pattern emerges when a cylinder is pressed directly from above, actually strengthening the cylinder in the horizontal direction (fig. 479). These two types of folds and their variations were executed with both hard and soft textile material, e.g. paper and mohair. The sizes of the pattern were then altered, gradually proceeding towards a larger, architectural scale. On the whole, the basis for the development of self-folding textiles was defined in phase one.



Fig.480

Process

The following describes the second phase of the “Super-Folds” research. This total process is termed “**research-based**,” as research was the initiative for the development of this project. However, designing and sampling are also part of the development. All three actions happen simultaneously, greatly influencing each other. The process below is described in chronological order, titled as either research, design, or sampling-based steps; but, this does not mean that the actions were strictly done one after another. For example, research is conducted in later stages as well.

Research-based

As stated above, I joined the “Super-Folds” research from the second phase. Under Samira Boon’s supervision, I first became acquainted with the basic rigid-origami folds. Then we looked further into researches conducted on origami folds, origami architecture and deployable structures. This early research of phase two **aimed to derive detailed information about the optimal parameters of foldable structures**. In addition, we began to think of **application possibilities** and searched inspirations related to origami and folding.



Fig.481

Top, Fig.480 TextielLab. / Above: Fig.481 Paper models. / Opposite page, Fig.482-484 Sketches. / Fig.485 Yoshimura pattern forming a cave.

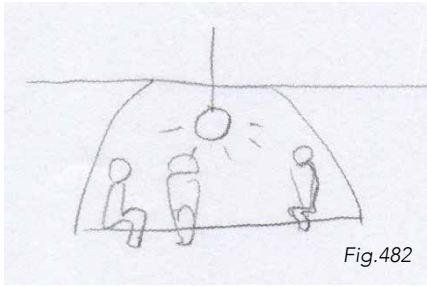


Fig.482

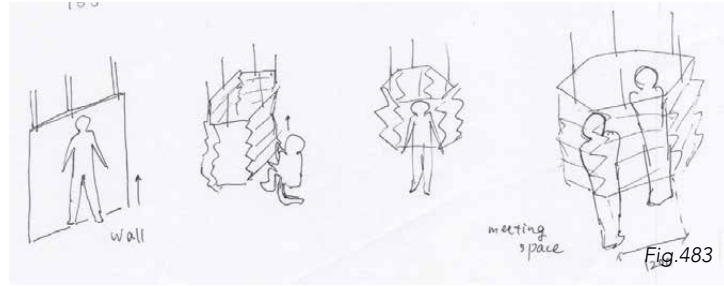


Fig.483

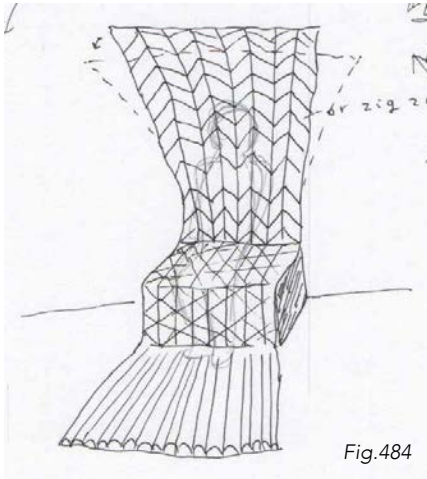


Fig.484

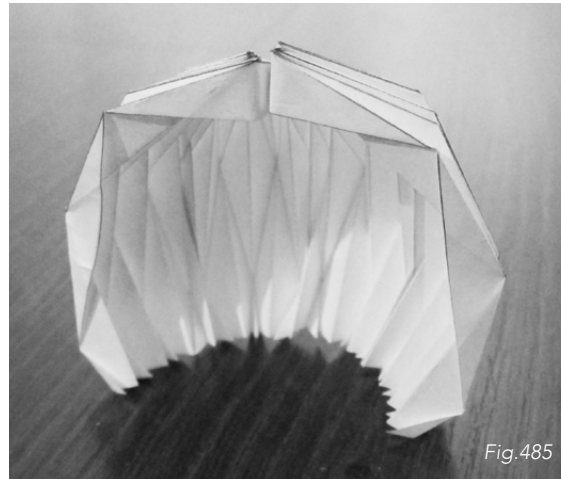


Fig.485

Design-based

Based on the research, we began to design foldable structures in architectural scale. Examples of the derived design were as follows:

- By combining soft textile material and flexibility of foldable structures, spatial partitions with acoustic properties can be achieved (fig. 482).
- When enlarged to architectural scale, cellular structures that are flat-foldable in two directions can have two functions: a 3D “room-in-room” and a flat partition (fig. 483).
- Numerous combinations of folding patterns and materials are possible, each demonstrating different properties. These properties could be examined further and utilized for different purposes, such as supporting different parts of the body in a chair-like form (fig. 484).

Research was again conducted, and we also experimented with the woven samples from phase one. New folding patterns were examined with paper models. These models also helped to visualize the effects of color and perception. Additional findings and ideas were:

- Angled surfaces can efficiently collect sunlight. Therefore, folded structures are optimal for solar power generation. In addition, the angles can be adjusted to the direction of the sun, and reflective yarns or colors can increase the amount of light collected.
- Flexible solar cells and small LEDs may be integrated into textiles.
- Small solar cells have been woven directly into other fabrics. This research is still in its developing stage, but perhaps solar cells can be integrated into folding textiles sometime in the future.
- A Yoshimura pattern structure seems to be able to self-support itself, not only as an arch, but also like a cave (fig. 485).
- The Freeform Origami software developed by assistant professor Tomohiro Tachi of the University of Tokyo can help to generate irregular patterns that are still flat-foldable.

By repeating the research and design process, we eventually **formed ideas worth sampling on the loom and consulting with other experts.**



Selected images from the sampling week.

Sampling-based

In close collaboration with the TextielLab, we aimed to achieve and test the following points during an intensive sampling week:

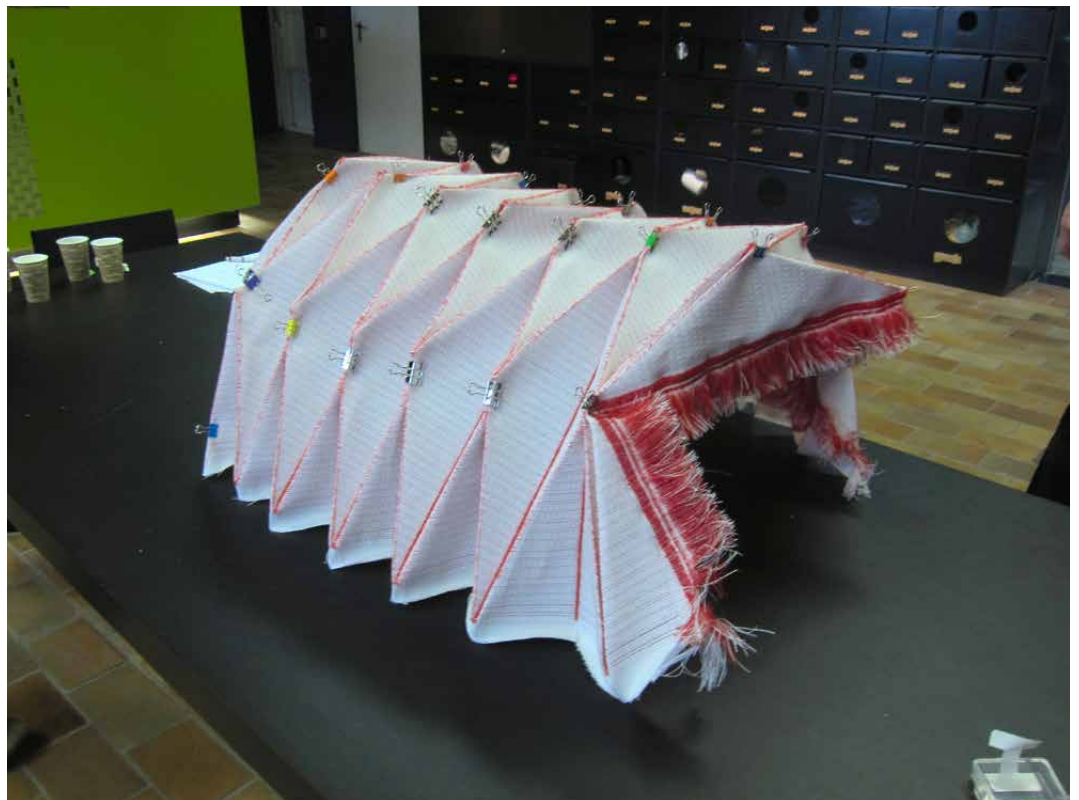
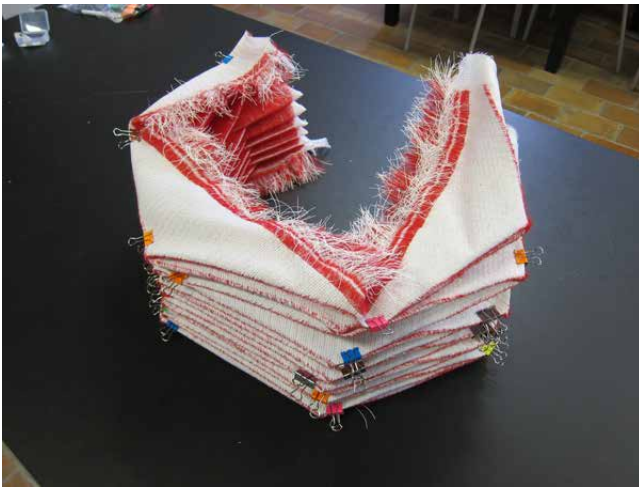
- The strongest foldable structure in architectural scale
- More diversity in folding patterns, besides the basic Miura-ori and Yoshimura pattern
- Adding additional traits with colors, floats, and transparency

Numerous samples were produced based on the above goals. One production and its analysis would lead to another sample or even multiple samples. Continuous discussion with the weaving programmer and technical weaver helped materialize our ideas. All information and corresponding images were gathered for review afterwards.

Much was learned and accomplished during the sampling session. The following are some of the findings:

- Self-supporting structure with a Yoshimura pattern can be achieved using a precise combination of special yarns.
- Irregular patterns we generated with the Freeform Origami software are foldable but are not so compact compared to the basic patterns.

After analyzing the samples, I finalized one design proposal that is both effective and realizable based on the overall research.



Proposal / "Poly-Pod"

As mentioned in Chapter 4, designers and clients are urgently seeking **flexible elements that are acoustically independent**. Such elements are most commonly needed in offices and large event spaces where sound reflection becomes a disturbing factor. I propose an effective, foldable “pod” structure – a “poly-pod” – for these circumstances.

Based on the “Super-Folds” research and the roles discussed in Chapter 3, the main roles of this pod will be the following (fig. 486):

Functional and Technical Roles

1. Acoustic Control

- Three-dimensional folds trap the sound
- Softness of the mohair and paper combination absorbs the sound
- The round, pod shape regulates the sound

2. Structure Function

- Crease patterns are pre-programmed in a Yoshimura pattern in a scale that can cover a sitting human (fig. 487)
- The basic unit is folded in half and connected; then, two of these units are combined to achieve stability (fig. 488)
- Whereas the wefts are soft material, the warp is a stiff material that enables structural independency

3. Visual Privacy and Temporary Division

- The pod is light and can be folded and assembled by one person
- Units can be easily assembled with zippers
- With three or four units, you can create an isolated space. Facing two pairs will create a small conversation space

Aesthetic and Atmospheric Roles

1. Spatial Placement and Scale

- The radius of the pod is a comfortable size that is suitable for one person to have sufficient space to work in

2. Textures and Structures

- Soft materials are used inside the pod to create a comfortable atmosphere

3. Colors

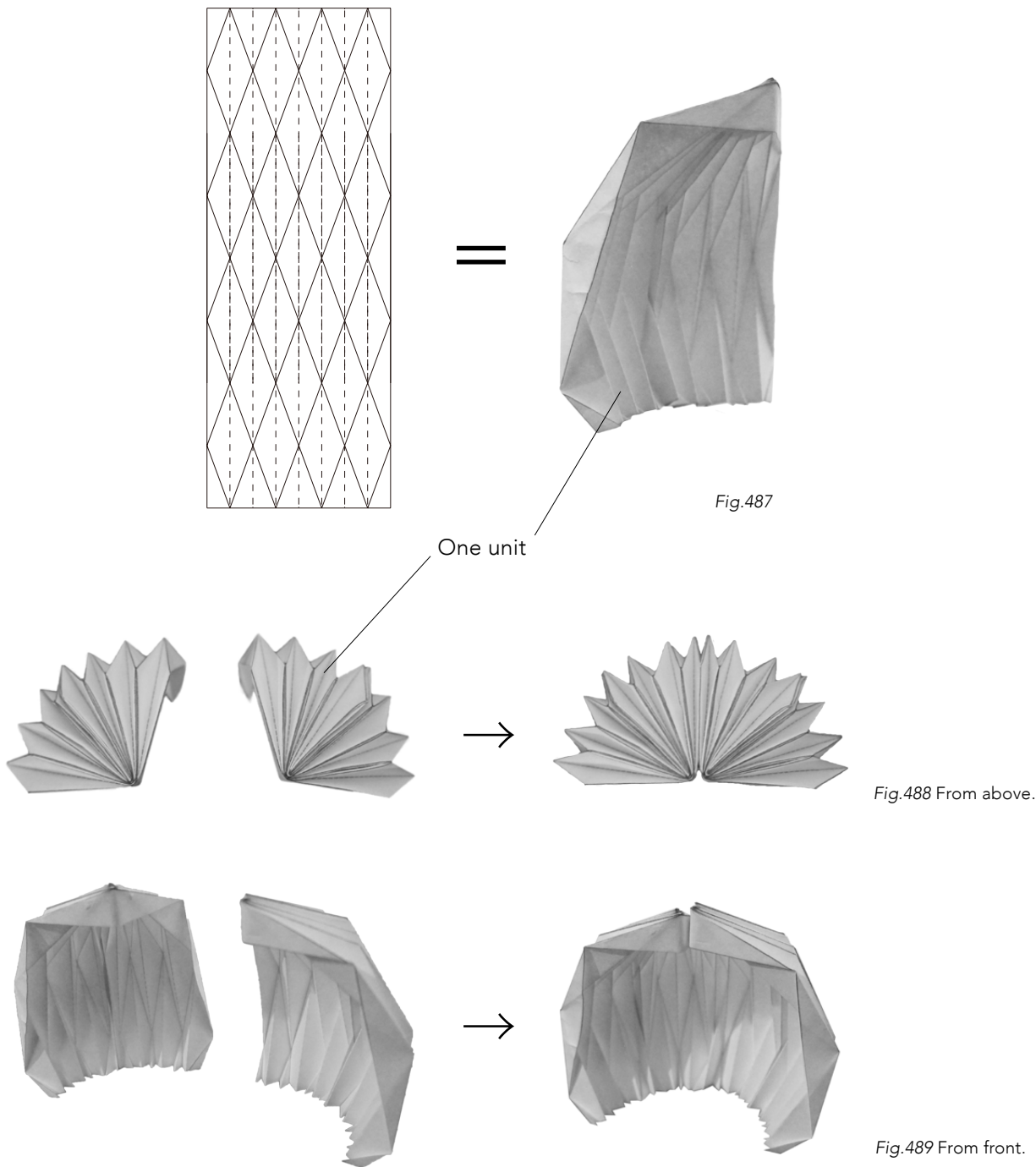
- The inside colors can be chosen according to the intended function, e.g. bright colors for paperwork, dark colors for a relaxed atmosphere

In this proposal, the aesthetic and atmospheric roles are closely related to the functional and technical roles. They are thus naturally derived from the pod structure.

Opposite page, from top to bottom, Fig.486 Selected roles. Darker color indicates stronger emphasis. / Fig.487 Folding pattern of a single unit. / Fig.488, 489 Two units are connected to create a stable structure.

Aim: To design a flexible element that creates an acoustically independent space

		FUNCTIONAL/TECHNICAL ROLES						
		Light Control	Temp. Insulation	Acoustic Control	Vis. Priv. & Temp. Div	Weatherproof	Structure Function	Other Func. Roles
Proposal 2	Poly-Pod							
		AESTHETIC/ATMOSPHERIC ROLES						
		Light & Transparency	Sp. Placement & Scale	Pleating & Layering	Way of Movement	Colors	Textures & Structures	Arch. Concept







Simulation of Poly-Pods in office space.

5.3 “IKIRU Edo-komon” – 3D-Expanded Tradition *Artistic Approach*

Background

Designers do not always have commissions or assignments given to them. Although problem solving and brief answering are important tasks, it is also meaningful to be able to propose novel ideas without a strict framework. These new sparks of ideas, even if they are not realizable at first, may push the limits, initiating new innovations that would not have been thought of without the emancipation of the mind. This can be considered similar to an artist's approach, as the initial trigger for the textile is not for problem solving, but it is more of a personal impulse.

My mission is **to revitalize traditional techniques and design**. I have long been intrigued by foreign cultures. Hence, living and studying in places outside my home country, Japan, has been a goal and dream. At the same time, my interest in my own culture grew stronger as well. I believe Japan has numerous traditions that are unique to the isle. Although some are becoming lost, there are also currently many people who are eager to maintain our strong heritage.

However, it is always very difficult to “revitalize” tradition, to utilize old techniques without devaluing its traits while simultaneously creating fascinating outcomes that are appealing to the people of today. Sometimes tradition-inspired products only copy certain aspects, and do not function to prolong the original tradition's life span. Respect should constantly be paid to the genuine approach. Therefore, I aim **to expand a tradition's atmosphere while keeping close to the original traits**.

Design Process

The tradition I would like to revitalize is the “**Edo-komon**” pattern used in kimonos (fig. 490). “Komon” is a type of kimono. Adorned by very small patterns, from afar the fabric seems plain. This traditional design dates back to when there were decorating restrictions during the Edo-period. These restrictions actually forced the development of new, precise techniques. The “Edo-komon” now refers to the kimonos that are made of single-colored silk. To create the delicate dots, pattern papers are cut by professionals. Around 800 to 1200 dots are opened within a 9cm x 9cm square (fig. 491). Glue is applied on top of the pattern paper, which prevents the dyeing of the kimono fabric in those precise parts, leaving them white. The dye master and the pattern creator are inseparable, and few of them exist nowadays.

Wishing the tradition's longevity, I aspire to develop a **three-dimensional Edo-komon fabric** that can exist in architectural scale. This idea formed when I was given the opportunity to use the laser-cutting machine at the TextielLab in Tilburg, the Netherlands. The technique was optimal to create the delicate patterns of the Edo-komon, and I was interested in combining the traditional pattern with modern technology while complying with my personal rule: keeping true to the genuine soul of the tradition.

I first decided to produce samples using different materials, to see how visible the shadows of the miniscule hole-patterns were when lit from behind. My intension was to laser-cut different parts of the pattern onto multiple layers, so that the entire pattern becomes apparent only when they are layered together. Unfortunately, the laser-cutting machine was not operational before the printing of this thesis; therefore, the simulations were done virtually.



Fig.490

Above, Fig.490 "Edo-komon" pattern. /
Right, Fig.491 Cutting the pattern paper.

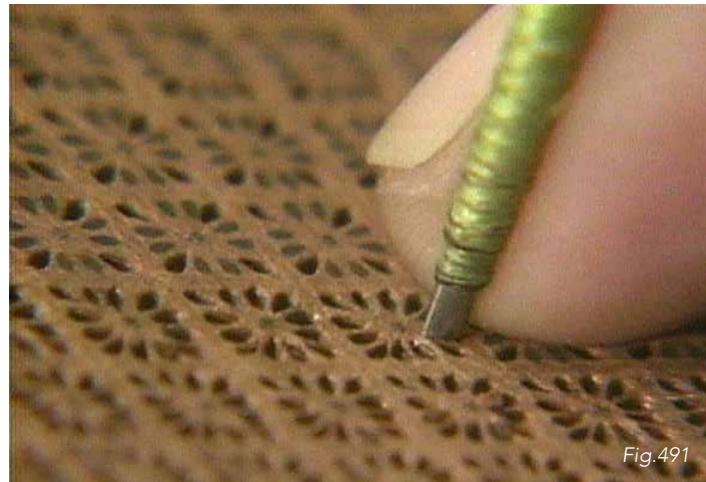


Fig.491

5

3

Proposal / "IKIRU Edo-komon"

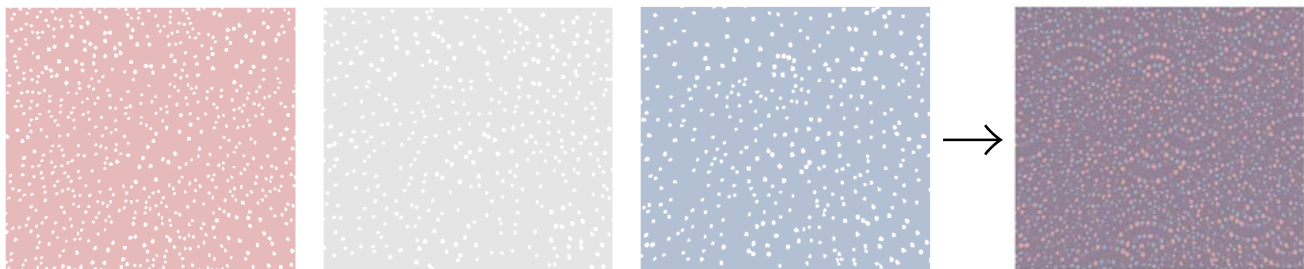
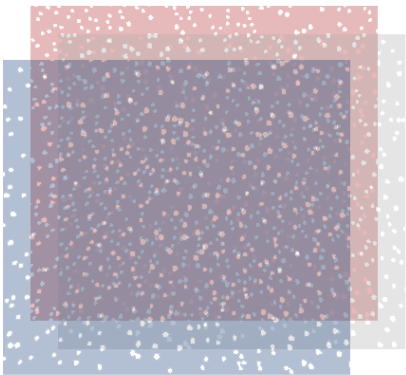
This concept focuses on the various aesthetic roles that an Edo-komon pattern textile can have (fig. 492). Various textures and transparencies will be laser-cut, then layered and placed in multiple positions to experiment with the following:

- Light and Transparency
- Spatial Placement and Scale
- Pleating and Layering
- Way of Movement

After sampling, suitable functional roles will be chosen to add even more value. For example, layered translucent Edo-komon fabrics most likely will ensure privacy in certain conditions. The functional roles will most likely be:

- Light Control
- Acoustic Control
- Visual Privacy and Temporary Division

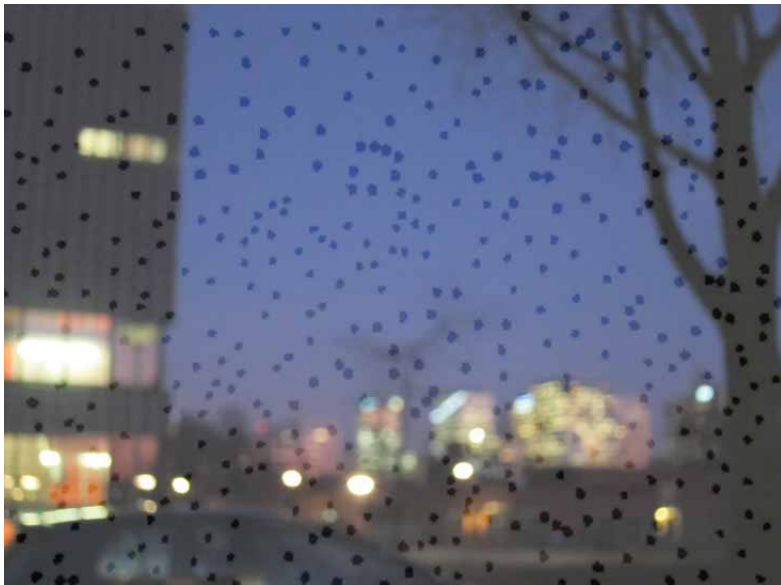
However, new possibilities may be discovered during the sampling process.



Aim: To design a spatial textile that revitalizes a space, inspired by tradition but utilizes modern technology

		FUNCTIONAL/TECHNICAL ROLES						
		Light Control	Temp. Insulation	Acoustic Control	Vis. Priv. & Temp. Div	Weatherproof	Structure Function	Other Func. Roles
Proposal 3	Edo-komon							
		AESTHETIC/ATMOSPHERIC ROLES						
		Light & Transparency	Sp. Placement & Scale	Pleating & Layering	Way of Movement	Colors	Textures & Structures	Arch. Concept

Fig. 492 Selected roles. Darker color indicates stronger emphasis.



By layering translucent fabric with different sections of an Edo-komon pattern, a three-dimensional textile wall is achieved.

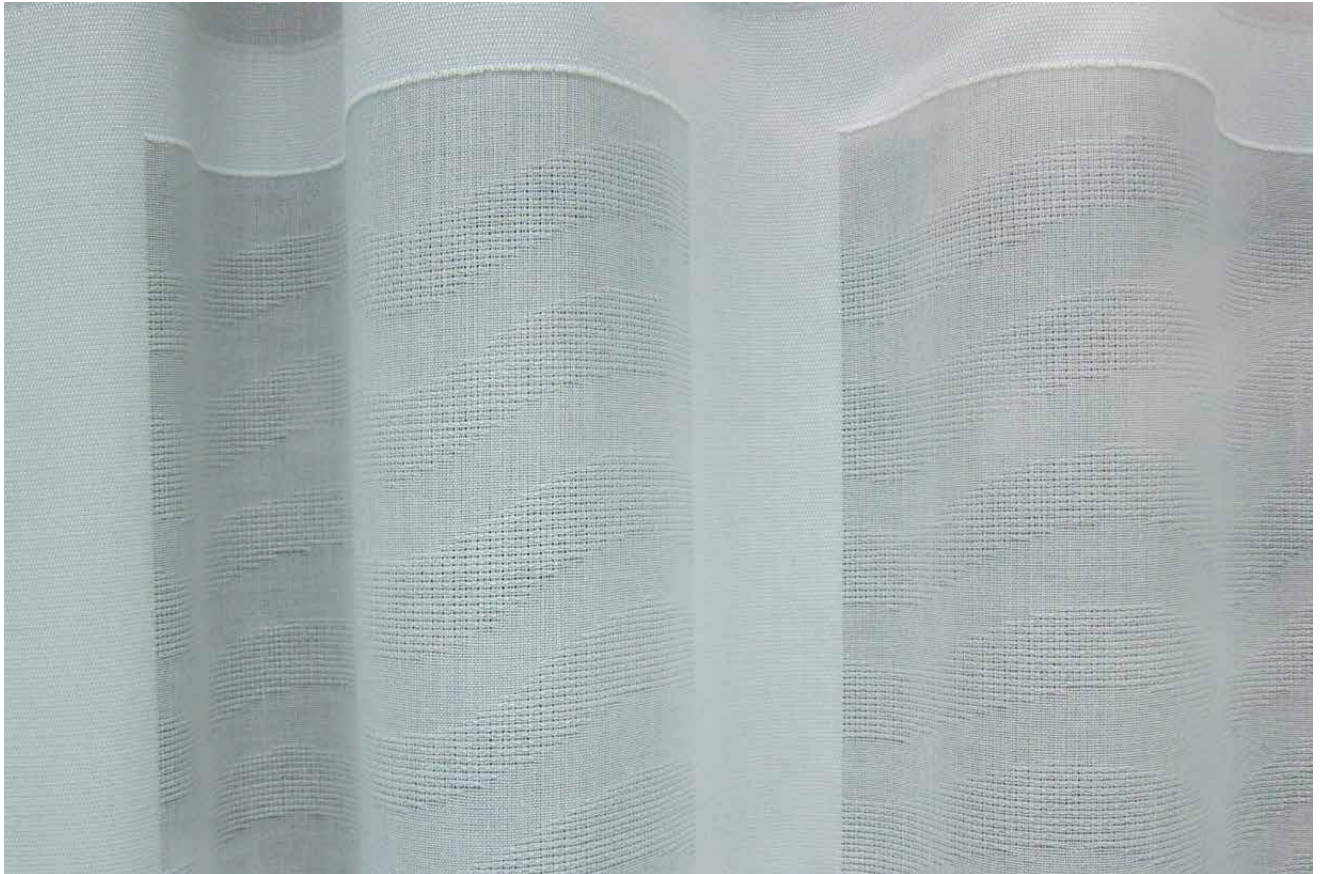
6 Conclusion

This thesis explored the overlapping field of textiles and architecture in multiple ways, aiming to learn more about the relationships, understand mutual benefits, as well as consider the human presence within the design process.

I maintain that there are two main reasons why textiles enhance space. First, in Proposals 5.1 and 5.2, the spatial textiles increased comfort in a public or open space. Textiles, with softness and tactility, bring warmth and a sense similar to the “home.” Emphasized in Proposal 5.1, using multiple textures, both sleek and woolly, enriched the otherwise monotonous glass surface of the Helsinki Music Centre. Furthermore, the proposed textile is not stationary, and movement of the textile affects the atmosphere both inside and outside. The curtain also invites human interaction with its “music score” design. On another note, Proposal 5.2 emphasizes the sense of comfort by generating a space that is human-scale. The Poly-pods can easily be installed by one person. In addition, the folding structure exhibits great flexibility, and the structure can be adjusted to one’s immediate needs. Overall, textiles can increase the spatial comfort of humans in all of the above ways, and these traits can be combined into one piece of textile. Moreover, textiles are more durable than paper and other natural materials. Textiles also have assorted functional and technical roles that truly improve architectural

environments. For example, Proposal 5.2 could indeed assist interior architects who were suffering from acoustic problems in their projects. All of the above merits are made possible with textiles. There is perhaps no other material that has this many benefits in architectural space. This is the power of textile material, and this is why it can enhance space.

The second main reason involves the extensive history of textiles. The beginning dates back to the first human shelters. There is an infinite number of examples, techniques, traditions, materials and colors of textiles. The variety is uncountable, and so much can be learned from what we already have created. At the same time, there is continuous progress in new textiles as well. As suggested in Proposal 5.3, tradition and innovation can be combined, leading to even more possibilities. This diversity allows highly specific goals to be met. Elaborate messages can be conveyed as well. In fact, clothing has long expressed human’s thoughts, and it can be asserted that we can also use textiles in general to “communicate.” In other words, we have an abundant source of both old and new textiles, and each unique or combined piece has its own character and sense of time. By diving into this sea of fabric, we surely can find the most suitable, necessary, or longing textile that enlivens our senses.



There are certainly many difficulties, challenges, and arguments about using textile material in architectural space. Often, it is difficult to translate ideas into practice. However many roles a textile may have, it is still up to the textile designer to design the actual piece. Textiles are also commonly considered vulnerable when compared to other building elements. Designers and architects sometimes even dislike the material for both conceptual and personal reasons.

Considering the above, difficulties and challenges can be solved with expert collaborations. Numerous collective work was covered in Chapter 3, indicating their potential. The problem actually lies most often in the lacking knowledge of the architect or other collaborator (Grönqvist 2014, Salolainen 2015). Without the consultancy of a textile designer or manufacturer, architects may choose inappropriate material for the case. Expert knowledge is immense. Therefore, by collaborating and supplementing each other's expertise, better outcomes may be achieved (Grönqvist 2014).

There will always be individuals who favor sophisticated and rigid styles, as there are always individuals who favor rich, flamboyant styles. Thus, it is understandable that textiles are not the utmost priority for architects when choosing materials. Even modern homes

are starting to last more than a century. Unfortunately, textiles are still vulnerable compared to the resilient stone, brick or wood structures that still stand today. However, I believe soft spaces, light structures and transient architecture will continue to develop within the near future. This new architecture will suit our lighter footwork and accommodate our abrupt needs and emergencies. As our ancestors gradually shifted to a permanent living environment, we may now shift back to the nomadic lifestyles of the past. Perhaps the shift seems extreme, but our lifestyles have already drastically changed in the past few decades. We travel more often and virtually meet and communicate with others. The sense of one's own "place" has more or less weakened.

I thereby conclude that textiles can create flexible spaces due to their pliability. Furthermore, the textures, scale and movement of textiles create a welcoming atmosphere, which add to or restore the sense of a "place," "habitar" or "home." This balance of flexibility and humanity is essential in designing our future society. Thus, textiles will continue to be implemented further in architectural space.

Above, Curtains of Aarnivalkean Koulu, Espoo, Finland.

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